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HANDLING MATERIALS ELECTRICALLY.

The use of the electric motor for moving materials is increasing at a surprising rate. There is scarcely a large factory erected, where heavy bodies are to be moved, that is not equipped with a complete system of electric cranes covering the entire floor space. Where material is to be moved regularly along a fixed route, we find an electrical conveyer. If the distance to be covered is large, and the material is moved in lots or varies in character, an electric telpherage system is adopted. In moving goods from floor to floor the electric elevator seems to be winning the fight. The reasons for this are not hard to see. They are: flexibility and ease of transmitting the required power; the ease and certainty of control; the electrical machinery is highly efficient and does not waste any energy when standing idle. On these points the electric system stands preeminent, and when these advantages are combined with that of drawing the requisite power from a central supply which would be installed anyhow for other purposes, it is easy to understand its popularity.

WEATHER REPORTS BY WIRELESS TELEGRAPHY.

The use of wireless telegraphy in reporting weather conditions to and from vessels at sea seems to be a useful field for this system. Long-distance transmission is not at present so much a necessity as is a reliable method of communication between ships, and ships and the shore. However, we now find the telegraph indispensable as a time-saver on land, and the wireless system promises to become just as necessary for communicating with vessels. Until this comes about, the use of wireless telegraphy for reporting storms at sea and for warning vessels of approaching bad weather will not only serve an exceedingly useful and valuable purpose, but will help to familiarize the public with the working of the system. At the present time few realize that they can use wireless telegraphy to communicate with vessels at sea advantageously, and it will be necessary to keep reminding telegraph users that the method is available. An excellent way of doing this will be to use it for reporting the weather; then vessels which are not now equipped with wireless telegraphic apparatus will rapidly be so equipped, in order that they also may receive this report.

THE PRIME MOVER SITUATION.

On another page of this issue we take pleasure in presenting an article entitled "The Prime Mover Situation," by Dr. Louis Bell. This gifted writer has a habit of dealing with his subjects in virile English and positive terms. The characteristics of the reciprocating engine are analyzed with reference to the steam turbine, and in comparison are brought up the characteristics of the gas engine. For a time it seemed as though the successes of the steam turbine were destined to drive from the field the practically outstripped reciprocating engine. Designers of the latter type of prime mover, however, have put forward their best efforts for refinement of design, with the result that once again the reciprocating engine is showing efficiencies that bring it more nearly on a level with the steam turbine. For many services it seems very likely that the reciprocating engine has still a broad field of opportunity. The gas engine, the ideal of so many inventive spirits, is surely coming into a better recognition, even on the part of those most sceptical as to its possibilities. The success which has attended the efforts of steam engine builders to overcome the lubrication problem with the use of high superheat renders more hopeful the solution of the problem of cylinder lubrication with the internal combustion engine. In a word, while the designers of both the reciprocating and the rotary engine must make their best efforts to improve one over the other, they have an extra necessity for original work, by reason of the rapidly developing possibilities of their common competitor—the internal combustion engine.

VOLTAGE REGULATION.

The problem of regulating the voltage in an electric station has always been troublesome. In the old days, when shunt generators held the field, the character of the supply depended upon the switchboard attendant, whose business it was to watch unremittingly the voltmeter, and adjust it when necessary, always keeping the pressure at a certain point. This system, while satisfactory so far as the average pressure of the system was concerned, was not satisfactory in other respects. The attendant could be depended upon to bring the voltage back to the normal whenever a change occurred, but this operation required some little time, and was only carried out after the voltmeter had indicated that the change was needed.

Automatic Regulation.

An automatic method of regulating seemed to be desirable, and this need resulted in the development of the compound generator, a machine which is self-regulating to a certain extent. The idea of the compound machine is very pretty. The change in load itself, acting through the compound winding, immediately effects the regulation without waiting for a change in pressure to take place. The compound machine, however, is not perfect, because the magnetization of the field is not directly proportional to the magnetizing current; and additional means, such as the series shunt, were found necessary in order to correct, to some extent, this defect.

Regulation of Alternating-Current Systems.

In the development of alternating-current systems, the same general course has been followed. First, the attendant was relied upon to maintain the voltage constant, his action being governed by a voltmeter or a potential indicator. Then the compound or compensated alternator was brought forward, the principle being the same; but, due to the necessity of rectifying the alternating current before passing it through the compounding coils, the alternating-current generator lost something of its simplicity by acquiring a commutator, with its delicacy and liability to trouble. In large alternators the compensating winding has, at times, given a good deal of trouble, and a method of avoiding this, which has recently been brought forward, is well worth notice. In this system the compounding is carried out not upon the alternator itself, but upon its exciter. The advantages are obvious. The compounding current is smaller, since it has to act upon a small magnetic field, the principal part of the compounding energy being supplied mechanically to this machine. The method is carried out by the usual rectifier on the alternator, but this can be made much smaller, and, in fact, the current taken from it merely controls the regulating system and determines the amount of the regulating energy which is drawn from a mechanical supply. The rectifier, while placed upon the larger machine, does not involve any particular difficulty.

While the methods of compounding alternators have thus been developed to a high degree, there is now another tendency. This is in reality a step backward in method, though the regulation is effected by new and highly developed devices. Before compounding came into general use, automatic regulators acting on the relay principle were tried, though the earlier of these devices proved unsatisfactory, when compared with compounding. More recently refined and improved systems have been developed which seem to place them in advance even of the compound or compensating system.

In regulating a constant-potential system, the voltage is the factor which must be kept constant; hence, it is logical to make the voltage of the system regulate it. Compound or compensating windings regulate according to the load, and not according to the voltage; therefore, unless special methods are devised, a varying power-factor seriously affects the potential of the system, since the compounding of the machine varies with the current only, while the regulation varies with the power-factor, as well as with the current. On the other hand, a regulator which depends for its action upon a change in the potential of the system, and which is set to keep that constant, will, if the device is capable of doing its work, keep the voltage constant, irrespective of the quantity or quality of the load. Such a machine, acting through the exciter, simplifies and cheapens the main generator, since the latter need have neither compound coils nor a rectifier. The automatic regulator takes the place of the switchboard attendant, but it can be made to act more delicately and far more quickly. On the other hand, since it works through the exciter field, and thus through the generator field, a little more time may be required for readjusting the voltage. It is doubtful whether this disadvantage is at all appreciable, because the regulator is constantly at work, and only in the case of sudden changes in the load does it allow the voltage to alter noticeably.

As has been said above, it seems logical to regulate the voltage of a system by means of a device operated by the voltage. Nevertheless, there was some reason for using the compound winding, and it is safe to say that this device will continue in use on direct-current machinery. Such machines already have a commutator, and the compounding adds no trouble on this account, nor is there a bothersome power factor to upset regulation; while magnetization of the field is not directly proportioned to the magnetizing current, correction is easily made for this. The system has the advantage, that a change in load instantly applies the correcting force, not waiting for a change in the voltage to take place. In this respect it resembles the so-called dynamometer governor, which was tried for steam engines, in which the governing was effected by the change in the load on the machine—not by a change in speed. The idea was excellent, but in practice it was found difficult to apply, as it seemed to be too sensitive. While such a system could, doubtless, be made satisfactory for continuous currents, it could not be applicable to alternators which must be driven at a constant speed, in order that the frequency may not vary. It is interesting to note that, while the alternator is itself a simpler machine than the continuous-current generator, in operation it has more to contend with. A continuous-current machine need only furnish a given voltage and regulate for varying currents. The alternator must supply a given voltage at a given frequency, and must regulate for varying currents and varying power-factors.

THE VALUE OF CHEMISTRY TO THE ELECTRICAL ENGINEER.

It does not take much thought to convince any one of the interdependence of the sciences. Nevertheless, one is being continually surprised by new facts which crop up and bring home a realization of how close this dependence is. The same condition obtains in the engineering professions, which are based on scientific foundations. One may compare these sciences and professions to a thickly branched tree, the trunk representing the great body of natural sciences, which, as it rises, branches out into great divisional sciences, apparently leading in widely diverging directions. Each branch then subdivides, each subdivision again dividing, and so on, until finally the twigs are reached, representing the latest developments in the science or art. Although the main divisions or branches start out in directions which should lead them further and further apart, the subdivisions leave this direction, and it generally happens that these smaller branches, while starting from different main limbs, approach each other and overlap, and twigs which have grown out from one main limb really lie closer to another limb than to that from which they have sprung.

At this time we are thinking more particularly of the relations between chemistry and electrical engineering. Chemistry, in fact, lies at the base of all engineering work, although one is apt to think of physics as being the true foundation. While physics is all-important, as it teaches us of the forces which we must control, chemistry tells us how we must make the materials with which to control these forces. The metallurgist would be at sea without his chemistry, and the electrical engineer could not build his dynamos unless the metallurgist, through his knowledge of chemistry, was able to produce satisfactory iron and copper. This is only one instance of a very general rule, that at some stage of the production of any machine, chemistry plays an important part.

There are to-day some large problems confronting the electrical engineer, and in nearly all of them it will be found that a knowledge of chemistry is essential. Take, for instance, the production of electrical energy directly from coal. It would be foolish for any one not familiar with the process of oxidation to attempt anything in this field. Yet, think of the time and money which have been wasted in trying to solve this, by methods any chemist would declare hopeless! Then, there is that other big task—the improvement of our electric lights. Here, again, it may be that the work will be done by one who has an intimate knowledge of the properties of the elements. Another line of work which is becoming daily more important is the study of insulating materials. The engineer has been using natural materials, working these up in various ways, doing the best he can with what he has on hand, and, while he has made great progress, he is still far from where he would like to be. This would seem to offer a profitable field of investigation to the chemist, and the successful man will surely reap a rich reward. Electrical engineering has branched out until it now extends into the field of chemistry. The student who is working his way painfully out along one of the branches of electrical engineering seldom appreciates how far from the main direction he is going, and how near to some other branch he is approaching. We may liken him to the ant, who industriously, but slowly, follows the old, beaten track up the trunk and out the branches to some particular twig. If he would take a bird's-eye view of his path from some other branch of science, he would see that the same point could be reached much more directly by following another route. The young electrical engineer, who can look at electrical problems with a chemist's eyes, will many times see clearly the right thing to do when a more experienced electrician would be all at sea.

"WIRELESS."

The generally accepted and, we may say, correct designation of the new method of transmitting intelligence is the "wireless telegraph." However, this expression has some drawbacks, one being the needless length of the combination. This undesirable feature is well recognized and various suggestions have been put forward in an effort to find a short, distinctive and suggestive name. Among many others we may mention the "etherogram," "aerogram" and "Marconigram." The first two are not euphonious nor do they slip easily from one's tongue. The last meets with opposition from the many inventors in this field who are not associated with the distinguished Italian. The purist probably objects to all three terms. None of the three is generally accepted, nor, for that matter, has any of many suggestions made been received with much favor.

Now one notices a tendency on the part of the public to shorten the usual designation to "wireless." This is distinctive and brief, and it looks well in a newspaper headline. Moreover, it has received the recognition of some technical men, though they usually seek protection under quotation marks. The term bids fair to become fixed by public usage.

The public is not always ready to accept the new terms proposed by the engineer or the scientist, and is apt to find one which suits it. If the new art or machine is likely to receive much attention from the layman, the inventor should bear this in mind and designate it by some concise, expressive term. Rœntgen was particularly fortunate in announcing his new discovery as X-rays. There was a novelty in the name which caught the public fancy and little heed was paid to the suggestion that it would be very proper to honor the distinguished discoverer by using his name. There was a certain justice in this position, but the world's conscience is easy in such matters, and probably but few of the non-scientific to-day associate the modest doctor with his great discovery.

As a new word has yet to be found which will meet with general favor, it seems likely that we will stick to wireless telegraphy, but the man on the street must have something short. No one speaks to-day of the "electric telegraph" or the "electric motor," except when comparing them with some other kind of telegraph or motor. So "wireless" it is likely to be, though he who talks and writes leisurely will probably add "telegraph" for some time to come, and thereby enjoy that pleasure which comes from the belief that he is a little better than his fellows.

The Prime Mover Situation.

By Dr. Louis Bell.

NOT since the period, now a half century gone, when Corliss revolutionized engine practice by the introduction of his valve gear, has the state of the art in the utilization of prime movers been in so complicated and critical a situation. With the doubts and fears have come, however, hopes, never brighter than now, of ultimate great improvements, certainly of great economic importance, perhaps even epoch-making.

With the steady tendency of fuel to rise in price, and the certainty that still greater increase impends in the not distant future, the matter of economical advances in utilizing fuel rises to a new importance. No man can say when the world's coal supply will give out, but this much is certain, that the coal measures in and near the great power-using countries have been already robbed to an extent that makes their decline obvious, and their fate a thing not very long to be averted. In Siberia, ice-bound for much of the year and reached only by costly circuitous lines of transportation at any time, there is an uncertain amount of coal, perhaps great, but relatively inaccessible. In Africa, too, that dark continent which will be the theatre of world-struggle and world-growth in the next century, there are probably stores of fuel now hidden and unknown. But for the present the situation is such as to make improvements in the economical use of fuel of fundamental importance. Doubling the amount of power obtainable from a pound of coal is the same thing as doubling the available coal supply—in fact, it is rather better, since it lessens the transportation charges, which are the most formidable factor in the price of coal, and also lessens the cost of handling and storing the fuel at the point of use.

Until about five years ago the steam engine had been growing in efficiency but slowly. It had been improved steadily, it is true; the simple engine had been made compound and the compound, triple expansion; condensation had become a common practice instead of an unusual one, and steam-pressures had been creeping upward, raising the thermo-dynamic efficiency of the machine. But for some years the steam engine had not changed radically or made forward strides in efficiency at any startling pace.

Then came the steam turbine, the most radical departure in heat engines since the days of Watt. It has done successfully what had been the aim of hundreds of inventors in substituting for a cylinder with a reciprocating piston a pure rotary effort much more convenient for many uses. It also, not of choice but of necessity, brought with it high relative speed which means large output for a given bulk and cost. This high speed is only in small measure a matter of design, for until the physical properties of steam are miraculously changed, steam turbines can be given low rotative speed only at the cost of forbidding complications. So far as electrical uses are concerned, the turbine gains over the reciprocating engine whenever the product is to be alternating current, and in the present state of things loses when direct current is to be produced. The simple rotary effort of the turbine enables a gain to be made in the avoidance of fractional losses which is particularly striking at low loads, and the machine is certainly most attractive in its compactness and convenience. But after all is said and done, the thermodynamic efficiency of a heat engine depends on the range of temperature of the working fluid, and the turbine, being subject to this limitation, fails to show any marked improvement in efficiency over the reciprocating engine. In fact, the results of tests have pretty uniformly shown a full load economy not materially different from that of a compound condensing engine working at the same pressure, vacuum and degree of superheating. It would be putting the case far too strongly to say that the turbine is a failure as regards steam economy. It is not; but it has yet to equal the best performances of triple-expansion engines or to approach them so closely as to give a lower total cost of power, including fixed charges.

The coming of the turbine has, in fact, goaded the engine builders, temporarily dozing under the soporific effect of standardization, into sudden and prolific activity. They have awakened to the value of high superheating and high vacuum, to say nothing of increased steam pressure, and quickened rotative speeds, and the results are already apparent. The structural form of a reciprocating engine is, without doubt, disadvantageous compared with the simple rotating parts of a turbine, but the former undoubtedly works at a speed of rotation very much more convenient for most purposes than that of a turbine, and which can be materially quickened so as to gain in output for a given weight and cost. A series of very striking tests were recently published giving results from a Willans engine of a little over 200 horse-power, running 400 turns per minute, and worked triple-expansion with high pressure, vacuum and superheating. The results were of a most startling character, reaching as low as ten pounds of steam per horse-power-hour at full load, and holding economy at moderate loads nearly as well as a turbine. No turbine, however, of similar or even much larger size has equalled its full load economy, while the speed of rotation in the engine was undeniably far more convenient for general use than is the speed of a moderate-sized turbine. And this result is not an isolated one—the performance of an engineering freak—but has been duplicated and even exceeded in full load economy by engines tested in Germany under similar conditions during the current year. It seems to be definitely determined that a triple-expansion engine, under favorable conditions and with, say, 250 degrees of superheating, can be depended on to give the horse-power-hour on about ten pounds of steam. This means that the longed-for figure of a horse-power-hour for a pound of coal is practically in sight. Engines capable of such work are by no means now common—they have been developed under the stress of fierce competition abroad, and perhaps there is not a single example of such remarkable machines in this country. But the thing exists just as the steam turbine existed for some years before American engineers got around to it, and we shall have our turn at it. The German engineers have been working at high superheating for a decade or more, and in spite of predictions to the contrary, seem to have overcome the difficulties of lubrication that have been encountered. This done, superheating must become as regular a feature of engine practice as is condensing. Each has for its end the same thing—an extension of the temperature range of the engine—and of the two, lubrication once settled, superheating is by far the simpler and cheaper.

One has, therefore, in sight at the present time not only the turbine which tends to keep down the fixed charges against power and to lessen the losses at moderate loads, but greatly improved multiple expansion engines, cutting down the fuel required for steady output to a figure that seemed well nigh impossible a few years

ago. These are the first fruits of the new century in delaying the time in which fuel will be a rarity and the children of men hard pressed to maintain their ground. And as between turbine and improved engines, the battle is now on. It is likely to be for some time like the reports of the Russian-Japanese war sent in via Chefoo—first Admiral Daminski's fleet is sunk again, and then General Nosho's attacking column is hurled back from the Russian works with a loss of 100,000 men. Personally the writer has no hesitation in saying that he is at present on the fence awaiting developments.

Meanwhile both combatants must look out for an attack from a common foe by the flank. The internal combustion forces are on the march and are wonderfully well provided with heavy artillery. There is small need of explaining such engines to the readers of the ELECTRICAL REVIEW, but few even among engineers are fully aware of the situation as it stands to-day. Even the writer, who tried to go about with his eyes open, received something very like a galvanic shock when an engineer of his acquaintance dropped in with a proposal and a guarantee of a brake horse-power-hour on one pound of coal in the producer for a hundred horse-power gas engine.

The simple fact about the gas engine is that when it comes to a question of range of working temperature there is nothing else in the same class. Given a solution of the lubrication problem and the internal combustion engine knows no peer in economical power production. It has a thermodynamic efficiency more than double that of the best steam engine that human ingenuity has devised and a far better chance for sensational improvements. Of the total heat energy of the gas the best modern engines can, roughly, deliver one-third as power, while one-third is rejected in the water circulation and one-third in the exhaust. The heat losses in these latter fractions must be regarded as being, to a considerable extent, avoidable, since the heat rejected is still at fairly high temperature. Consequently, it is not in the least unreasonable to look forward to engines of fifty per cent efficiency, and very likely more.

The difficulties involved in proper lubrication of the working surfaces of a gas engine are undeniably great, far greater than in the case of superheated steam, but they have certainly been conquered in great measure for engines of small and moderate power. Thanks to the growth of the automobile, a great deal of talent has been concentrated upon internal-combustion engines of late, and results may confidently be expected.

Big internal-combustion engines present far more difficulties than small ones, but it seems now reasonably certain that good results are attainable and have already been reached. The question now presented is a question not of theory, but of fact, as to whether at the present time a gas engine say of 1,000 horse-power can save enough on fuel to outweigh the added fixed charges, maintenance and repairs. On this point, as is well known, engineers differ radically. They differ, of course, in their estimate of these contingent items, and it is to be noted that men who have had practical experience with such engines take a far more optimistic viewpoint than those who have not. Just now the commercial situation is such that much allowance should be made for divergent opinions on this point. No well-seasoned steam engineer enjoys the prospect of a sending of gas engines, and he takes instinctively the position of a hardened skeptic, while men really acquainted with internal-combustion engines of large size are rare and usually have axes to grind.

Electricians can readily run back over the history of the art and recall many similar situations—inventions that were scoffed at until they carried all before them, and others that hung on the verge of practicality until they were finally swallowed up.

But the gas engine is even now—as the editor of the Waybacque *Bazoo* would put it—"in our midst." We dodge it daily upon the streets, or drive it amuck and dodge the brickbats of the alarmed populace. As a source of power on a large scale it must be taken very seriously. No amount of doubt and scoffing can put it down until it has been given an exhaustive trial. From the standpoint of the electrical engineer it must do something more than show economy in fuel; it must prove to be thoroughly reliable and regulable. In the latter respect it has not yet thoroughly proved its possibilities, and in the former, time must tell. As a single-acting engine, it lacks a certain delicacy in regulation, and only its more complicated forms seem likely to be satisfactory in this respect. But we must not forget that the tendency in modern electrical practice is toward great plants run at relatively steady loads. On a large system minor irregularities of demand are lost in the shuffle, and the main concern is in adding or subtracting the proper number of units to give reasonably near full load on all in use.

In this three-cornered fight between steam engine, steam turbine and gas engine it by no means follows that because of the struggle one will emerge as the unquestioned victor. It may well happen that each will retire to its respective territory to nurse plans for a policy of expansion. This might prove a very desirable ending, giving a wider choice of prime movers suited to various purposes. At all events, the struggle now on will certainly, unlike ordinary warfare, end by strengthening each of the combatants. There has been nothing so near actual savage competition in any large field for years, and the power-using public will certainly reap the benefit of it. Indeed, the harvest has already begun.

Locomotives and Motor Cars of the Paris-Orleans Railway Company.

The Paris-Orleans Railway Company was the first trunk railway to make any important transformation of its existing lines. It opened in May, 1900, an extension of its existing lines in Paris, operating all the incoming and outgoing trains electrically. The locomotives used were of the Baltimore-Ohio type. This company, according to Mr. M. Vingoe in the *Electrician,* London, has recently added three new locomotives. These have the same power as the old, with similar trucks, but the cabs are arranged differently, there being one cab at each end.

The Paris-Orleans Railway Company has also secured, in addition, five motor cars equipped with the Sprague-General Electric multiple control system. All the cabin cable used in both locomotive and motor cars is covered with asbestos grade, painted to avoid abrasion.

The locomotives are thirty-three feet four inches long, nine feet four inches wide, twelve feet eight inches high, weigh fifty-five tons, have a wheel-base of seven feet ten inches, and the distance between centres of trucks eighteen feet six inches, with a wheel diameter of forty-nine inches. The motor cars are fifty-six feet eight inches long, nine feet two inches wide, twelve feet six inches high, weigh thirty tons, have a distance of forty feet eight inches between the centres of trucks. The wheel-base is six feet six inches and the wheels forty inches in diameter.

The service which the electrical equipment performs is to haul from Juvisy, a suburb on the southeast of Paris, distant fifteen miles from the terminus, to Paris and back, a total of over 200 trains daily at speeds varying from thirty to forty-five miles per hour.

The International Electrical Congress.

The Entertainment of the Participants in the Circular Tour after Leaving Montreal, September 7; the Arrival at St. Louis, and the Opening Sessions of the International Electrical Congress.

MOST of the participants in the circular tour arranged by the American Institute of Electrical Engineers for the foreign delegates, visiting electrical engineers and guests, continued the journey to St. Louis, though a number of the party which left New York on the morning of September 6 dropped out at Montreal. The events of the trip from New York to and including Montreal were chronicled in the issue of the ELECTRICAL REVIEW for last week.

After the trip, on September 7, to the power station of the Montreal Heat, Light and Power Company, where luncheon was served and addresses made by Professor Moisè Ascoli, president of the Associazione Elettrotecnica Italiana, and Mr. B. J. Arnold, president of the American Institute of Electrical Engineers, special cars took the visitors on a trip about the city. Late in the afternoon the members and delegates attended a reception given by the chancellor and governors of McGill University. In the evening a garden party was given in honor of the visitors by the Forest and Stream Club, of Dorval, on Lake St. Louis, twelve miles from Montreal. The party returned to Montreal at midnight.

On Thursday, September 8, a number of the guests participated in a trip to Shawinigan Falls, as the guests of the Shawinigan Falls Water and Power Company. The country between Montreal and Quebec on the north side of the St. Lawrence, through which the Great Northern Railway runs, has only recently been opened up to tourists, and the members of the party, which filled two cars, were surprised and delighted with the scenic effects along the road. A short stop was made on the trestle over the gorge at Maskinongé falls, about forty-five miles from Montreal. The river runs under the railroad track at this point, and, making a sharp turn, falls parallel with the bridge for an abrupt distance of 100 feet. The Shawinigan Falls station was reached at noon, and the party visited first the Shawinigan Carbide Company, where they witnessed the production of carbide at this plant. Following this, the visitors were conveyed to the hotel, where a collation was awaiting them. After dinner the Shawinigan falls were visited. The St. Maurice river at this point drops 180 feet in a distance of about 200 yards, when the water flows for about a quarter of a mile through a narrow, rocky gorge into a wide bay or lake. The power station of the Water and Power Company was next visited, and the various features of the plant were briefly explained by Mr. Wallace C. Johnson, the engineer of the company; by Mr. Lehman, resident engineer, and other officers. This plant is already delivering over 35,000 kilowatts, and the falls have a present capacity of over 100,000 horse-power at minimum low water. During the entire trip Mr. A. J. Gorry, manager of the Shawinigan Water and Power Company; Professor R. B. Owens, Messrs. W. B. Warren, W. C. Jackson and other officers and members of the local reception committee made every effort looking to the comfort and entertainment of the visitors.

The party made a fast trip back to Montreal, so that they might connect on time with the Institute train for Buffalo. The ninety miles between the Shawinigan falls and Montreal were made in two hours and forty minutes. Here the party were marshaled under Mr. E. H. Mullin, chairman of the transportation committee of the American Institute of Electrical Engineers, and the train for Buffalo left the Bonaventura station at 8.15 P. M.

Niagara Falls was reached on the morning of September 9, breakfast being served on the train. The forenoon was spent at Niagara in visiting the falls, together with a trip down the gorge to view the whirlpool and rapids. After luncheon the party were the guests of the Niagara local committee, and visits were paid to the power-houses of the Niagara Falls Power Company, the Niagara Falls Hydraulic Power Company and some of the electrochemical manufactories to which power is supplied from the falls.

Passing through Canada and the city of Detroit, Mich., the members of the tour arrived in Chicago on the Michigan Central special at 7.30 A. M., Saturday, September 10. The party were conveyed by buses to the Auditorium Annex, where the entire parlor floor had been reserved for them. Breakfast was served in the palm room from 7.45 to 9 A. M. After breakfast a general tour was made to points of particular interest to electrical engineers. Automobiles conveyed the visitors to the Fisk street station of the Commonwealth Electric Company, of Chicago. The party spent over an hour inspecting this station, and after this traveled past the large plant of the Western Electric Company and viewed one of the Chicago Edison Company's distributing substations. Upon arrival at the Chicago Telephone Company's building, at Washington and Franklin streets, an inspection of the main exchange was made, after which the party returned through the retail district to the Annex for luncheon.

Special tours were made up for those not desiring to take the general tour. Among the places visited were the automatic telephone exchange and the underground tunnels of the Illinois Tunnel Company, the Western Electric Company's manufacturing establishments, the Chicago Edison Company's Harrison street station and a number of substations, the Union loop and elevated railroad system, the electric elevator and general power motor installation in Marshall Field & Company's retail stores, and the Deering & McCormick branches of the International Harvester Works. A number of ladies took advantage of the opportunity of each of these trips. Luncheon was served from 1 to 2.30 P. M.

The general tour of the afternoon consisted of a short cruise on Lake Michigan, on board the United States gunboat Dorothea, along the west shore of the lake. After the cruise, the party landed at the pier of the Chicago Yacht Club, and were conveyed back to the Auditorium by buses. An automobile trip was made in the afternoon through the South Side park system. A number of ladies attended both of these trips. An informal dinner was served at 8 P. M. in the palm room of the Annex. The party were then conveyed to the special Illinois Central train, which left Chicago at 11.45 P. M. for Springfield.

It may be said to the credit of the enterprising engineers of Chicago that they sent out as an advance guard a committee to meet the visiting engineers at Niagara Falls. This committee distributed programmes, invitations and bus tickets, and saw that each engineer was well posted on what to expect at Chicago. The chairman of the local reception com-

mittee was Mr. Samuel Insull, and Mr. J. Scribner and H. E. Niesz were the men of the advance guard.

Springfield was reached at 7.30 A. M., Sunday, September 11. Breakfast was served at the Leland Hotel after the arrival of the train, and a trip was made in trolley cars to Lincoln's tomb.

The party arrived at St. Louis on the afternoon of Sunday, September 11, and headquarters were made at the Jefferson Hotel. After dinner an informal reception was held at the Jefferson.

MONDAY, SEPTEMBER 12.

The first meeting of the chamber of delegates was called to order by Chairman Elihu Thomson of the committee of organization, at the Music Hall, St. Louis, 10 A. M., September 12. Professor Thomson introduced the Hon. David R. Francis, president of the exposition, dispensing with all formality in the preliminary business with which the congress was to have been opened.

President Francis stated that he greatly appreciated the honor of extending a welcome on this occasion, and regretted that his engagements were such that he could not remain during the entire session, and, in fact, during all of the sessions to which he might be granted admission. The character of the Electrical Congress was such as to commend it not only to the greatest consideration from the management of the exposition, but also from the municipality of St. Louis, from the state government, and from the national government. After describing the character of the universal exposition, President Francis continued, in part:

"I think it will be a long time, in this country at least, before another universal exposition is attempted. There will, of course, be international expositions in special lines, and the line which you represent is the one in which there is likely to be another international exposition before a great many more years have rolled by. The great advances which have been made in the science to which you have given your allegiance has rendered more than interesting any assembling of the different appliances and any demonstration of the different inventions and discoveries that have been made by the members of this congress or by the members of the allied organizations.

"There was some argument, if I may term it such, in the organization of this exposition as to whether electricity was entitled to recognition as a separate department. There was a claim made by the department of machinery that electrical appliances, when made instruments of utility, became machinery and consequently belonged in the department of machinery; and that there was no more occasion or necessity for a department of electricity than for a department of steam. I believe that those of you who will see the department of electricity which has been installed at this exposition will admit that the action of the administration of the exposition in determining that electricity should not only be a separate department, but should have the exclusive use of a large exhibit palace, was a wise conclusion. . . . The installation in the electrical department in this exposition is, in the judgment of the management, superior to any installation that has ever been given in any exposition. It is the result of the very faithful and intelligent efforts of the chief of the department of electricity. In so comprehensive an organization as a universal exposition, you can readily understand that there must be a number of men who are trusted to do a great many things without consulting any higher authority. . . . We congratulate ourselves on the classification of these exhibits. You gentlemen who are readers and thinkers know how difficult it is to make a comprehensive classification, and working classification, that will include all of the products of all the civilized countries on the globe. One of the departments of that division of exhibits, one of the great departments of that classification, is electricity.

"We might call electricity the new science. The discoveries that are being made in it from day to day will no doubt necessitate another classification or subclassification before another exposition is held, whether that exposition will be universal or an international exposition of electricity.

"The wisdom that has been exercised by the organizers of this congress and by those who have kept it in existence from year to year indicates a great breadth of view and a remarkable foresight in regard to the development of electricity. The different branches of this congress all demonstrate how far-reaching are the discoveries in electricity.

"St. Louis is glad to be made the scene of your fifth congress. The exposition management feels honored that the time and place of your meeting should have been influenced by the preparations that were made by the exposition for the purpose of bringing together the best products of all the peoples of the world. Permit me, on behalf of the exposition management, to express the hope that your deliberations may come fully up to your expectations; that you may visit the exposition exhibit of electricity; that your gathering here may be prolific not only of pleasure to yourselves, but that it may result in still further advances in the line of progress which you have pursued with such remarkable vigor and success the last decade."

At the conclusion of the address by President Francis, Chairman Thomson called attention to the fact that the committee of organization substantially finished its work on this occasion. In recalling some of the past history which led up to the organization of the congress, Professor Thomson said:

"The four hundredth anniversary of the discovery of America was celebrated in 1893 by the establishment of a great exposition. The Chicago International Electrical Congress, the work of which is doubtless familiar to many of those present today, was the first great gathering of electrical students and workers held in the Western Hemisphere. A little over one hundred years ago the then youthful but ambitious republic of the United States of America acquired from France by the expenditure of $15,000,000 purchase money the possession of an enormous territory extending from the shores of the Gulf of Mexico, west of the Mississippi river, northward and westward to the Pacific coast. The northern limit was undefined, and was settled long after by treaty with Great Britain. The tract includes every variety of farm land, forest, semi-arid and arid land. Much of the arid land is amenable to irrigation. The agricultural and mineral wealth is beyond estimation. The Louisiana Purchase must be regarded as an event not less important than any other in the history of this great nation, fitly to be celebrated after one hundred years by a great exposition, showing the results of human activity and progress in the arts, sciences and engineering—and might I add, especially in electrical science and engineering—the first in the new century just begun.

"It was natural that an international electrical congress should have been deemed desirable. Accordingly, a committee of organization was called together by the exposition authorities. The committee in undertaking the work realized that the task was not a light one, and invoked the aid of the American Institute of Electrical Engineers and the other societies which have affiliated themselves with the congress. The work of the committee of organization is completed by this meeting, and the choice of permanent officers is now in your hands."

Professor Thomson paid a warm tribute to Dr. Arthur E. Kennelly for the

time and effort which he had spent in the development of the congress. He also called attention to the valuable work of Mr. W. D. Weaver, and thanked the various scientific and technical bodies for their assurances of cooperation and their representation.

Colonel Samuel Reber moved that the president appoint a committee of three to report to the congress on officers for permanent organization. This motion was seconded and the chairman appointed Colonel Reber, chairman, Professor John Perry and Professor L. Lombardi, and requested that the committee immediately begin its deliberations.

Dr. H. S. Carhart moved that a committee of three be appointed by the chair to nominate honorary officers of the convention. This was seconded and carried, and the chair appointed Dr. Carhart, chairman, Mr. W. D. Weaver and Dr. Carl Hering.

Chairman Thomson then called upon Mr. R. Kaye Gray, president of the Institution of Electrical Engineers, of Great Britain, to respond on behalf of the British Institution to the address of President Francis.

Mr. Gray stated that he could say for the Institution of Electrical Engineers, of Great Britain, that they felt very much pleased when they received the invitation to go to St. Louis and to take part in the International Electrical Congress. This pleasure was made the greater when there was received from the American Institute of Electrical Engineers a cordial invitation to become their guests. Another pleasure which had been experienced in the United States since their arrival was the meeting with the colleagues from Italy. Never before, said Mr. Gray, had such a programme been laid out as had been prepared for this congress. Any one who had at any time taken part in the organization of meetings, though of very much smaller proportions than this congress, could well appreciate what an enormous amount of labor had been expended. He had heard how much Dr. Kennelly and how much Mr. Weaver had done, and he wished to take this opportunity, while he was in command of the platform, to break through the veil of modesty which was so well known in Professor Elihu Thomson, and give to him his due meed of praise.

Chairman Thomson, in introducing Professor Moise Ascoli, president of the Associazione Elettrotecnica Italiana, said that there was not only a splendid representation from the Institution of Electrical Engineers, of Great Britain, but a most unusual representation from the Italian association.

As the head of this delegation, Professor Ascoli said that it was an exceptional fact that so considerable a number of Italian engineers should join in a visit to the United States. It was the first time, he thought, that such a large delegation had visited this country. The delegation already had a splendid proof of the hospitality and of the sentiments of friendship from the Americans who had entertained them in the past few days. They had an opportunity of seeing and highly appreciating the great results of organization, which was the special characteristic of American work.

Professor Thomson called upon M. Guillebet De Nerville to speak, not only on behalf of France, but on behalf of other nations which were represented to a greater or less degree. M. De Nerville addressed the meeting in French, and expressed his pleasure in being in attendance on the congress.

Professor W. E. Goldsborough, chief of the department of electricity, was called upon to speak relative to the magnificent installation of electrical exhibits. Professor Goldsborough spoke at some length concerning the various installations, and the part which they represented in the historical presentation of the development of electrical engineering. On the part of the electrical men of St. Louis, he extended a very cordial welcome to the delegates and members of the congress.

On calling for the report of the nominating committee, Colonel Reber presented the following officers for the permanent organization:

President, Professor Elihu Thomson; secretary, Dr. A. E. Kennelly; treasurer, W. D. Weaver; vice-presidents, Bion J. Arnold, Dr. H. S. Carhart, Professor W. E. Goldsborough and Professor S. W. Stratton. For officers of the sections, the following: Section A—Chairman, Professor Edward L. Nichols; secretary, Professor Howard T. Barnes. Section B—Chairman, Professor Charles P. Steinmetz; secretary, Professor Samuel Sheldon. Section C—Chairman, Dr. Henry S. Carhart; secretary, Dr. Carl Hering. Section D—Chairman, Charles F. Scott; secretary, Dr. Louis Bell. Section E—Chairman, John W. Lieb, Jr.: secretary, Gano S. Dunn. Section F—Chairman, Dr. Louis Duncan; secretary, A. H. Armstrong. Section G—Chairman, Francis W. Jones; secretary, Bancroft Gherardi. Section H—Chairman, Dr. William J. Morton; secretary, William J. Jenks.

Mr. R. Kaye Gray then took the chair, and asked for the approval by the congress of the report by the committee on nominations. On the motion of Colonel Reber, the report was accepted and a vote was passed by acclamation.

President Thomson thanked the congress for this endorsement, and said that the main object of the congress will have been fulfilled if there is brought out in its papers and discussions the best thought and work in the electrical field. There was no need to dwell upon the great growth which had taken place and was now going on in electrical science and engineering. Not only had it made great revolutions in methods of lighting in power systems and transportation, in communication of intelligence, and in many other fields of engineering, but the conceptions of the nature and workings of the forces in the universe—even the nature of matter itself—are and will be affected. It is too early even to suggest that electricity will be the study of the alchemist of the future. The research in pure science seldom takes account of engineering and industrial possibilities. It is well that it is so, but, from the present standpoint, the electric arc of Davy, the voltaic couple, the magneto electricity of Faraday, the electric waves of Hertz, as examples, merely show how the results of enquiry undertaken for its own sake may become the bases of enormous industrial development. The future of science, and particularly electrical science, is boundless. The chemist must possibly accept an electrical atom; the physicist, an electrical inertia. Since the ether is only known to possess electromagnetic properties—whatever that may mean—matter and all immersed therein may be electrical.

The committee on the election of honorary vice-presidents, and honorary chairmen and vice-chairmen for the various sections, presented its report, through Dr. H. S. Carhart:

As honorary vice-presidents, Professor Moise Ascoli, Col. R. E. Crompton, Dr. R. T. Glazebrook, Senor Gonzales, R. Kaye Gray, Professor L. Lombardi, Professor John Perry, Professor H. Poincare. For honorary chairmen and vice-chairmen of the sections: Section A—Professor Svante August Arrhenius, chairman; Professor W. Lash Miller, vice-chairman. Section B—Professor G. Grassi and Professor Charles Zipernovsky, chairmen; W. Duddell and Professor Ferdinand Weber, vice-chairmen. Section C—Professor W. Ostwald, chairman; Mr. Dennery, vice-chairman. Section D—Paul Janet and A. Maffezzini, chairmen; Emanuele Jona, vice-chairman. Section E—M. Otamendi, chairman; Jorge Newberry and R. R. Arizpe, vice-chairmen. Section F—Baron Wolfgang Ferstel and Mr. Sandick, chairmen; M. Latour, vice-chairman. Section G—John Hesketh and H. E. Harrison, chairmen;

Messrs. Ferrie and Shields, vice-chairmen. Section H—Dr. H. Bergonie, chairman; M. De Nerville, vice-chairman. These gentlemen were elected by acclamation.

The secretary, Dr. A. E. Kennelly, announced that a lecture would be given to Section C on Tuesday evening, at 8 o'clock, in Library Hall, in the west wing of the Administration Building, at the World's Fair Grounds, on alumino-thermics, by Mr. H. Goldschmidt. All the members of the congress and members of the American Electrochemical Society were invited.

On behalf of Section B and Section F, on Tuesday morning there would be a joint session to read and discuss papers relating to the theory and application of alternating-current railway motors. He announced for the local reception committee that a branch post-office department had been established, for the convenience of the delegates, at the east end of the main corridor in the Coliseum building, and that the Western Union and Postal Telegraph companies had established offices in the same hall. The Bell and the Kinloch telephone companies had placed free telephones in the building for the use of the congress members. The long-distance company, the American Telephone and Telegraph Company, would also furnish free service from a booth in the secretary's office. Announcement was made that there would be two joint meetings between the Institution of Electrical Engineers and the American Institute of Electrical Engineers with the congress or sections thereof. The first of these joint meetings would be held on Tuesday morning at 10 o'clock, in connection with Section A. The second meeting would be held on Wednesday morning, at the World's Fair grounds, in Festival Hall, at 10 o'clock, in connection with the congress, to discuss the application of alternating current to electric traction.

After the opening exercises, the congress broke up into sections to hear and discuss papers. In Section A, the paper by Professor H. T. Barnes, on "The Mechanical Equivalent of Heat, Measured by Electrical Means," was read by the author. This paper was submitted by the Royal Society of Canada. Dr. Arthur E. Kennelly read a paper entitled "The Alternating-Current Theory of Transmission Speed Over Submarine Telegraph Cables." Papers by Dr. John Trowbridge and J. W. Townsend, on "The Spectra of Gases at High Temperatures," and "The Theory of Ionization by Collision," respectively, were read by title.

In Section B, papers by W. M. Mordey, B. A. Behrend, and by M. Nodon on rectifiers; by Dr. Clayton H. Sharp, on "The Equipment of a Commercial Testing Laboratory," and by J. Jona, were read and discussed.

There was not much accomplished on Monday morning by Section C, only one paper being read. This was by Professor T. W. Richards, on "The Relation of the Theory of Compressible Atoms to Electrochemistry."

In Section D there was but one paper read. This was an interesting description of the electrical transmission plants in Switzerland. The author, Signor E. Bignami, was not present, but the paper drew out some interesting reminiscences from Dr. Louis Bell and Charles F. Scott, relating to the early applications of polyphase currents to transmission in this country.

In Section E, the papers by W. C. L. Eglin, on "Rotary Converters and Motor-Generators in Connection with the Transformation of High-Tension Alternating Current to Low-Tension Street Current;" by George Eastman, on "The Protection and Control of Large High-Tension Alternating-Current Distribution Systems;" by E. de Fodor, on "Rates for Electricity Supply," and by Arthur Wright, on "Recent Improvement in Electrolytic Meters," were read and provoked an interesting discussion.

In Section F, the paper by Philip Dawson, on "Electrification of British Railways," drew out considerable discussion and decided views from a number of electric railway men.

In Section G, the papers by Joseph Hollos, on "Simultaneous Telephony and Telegraphy," and by Saitaro Oi, were read.

In Section H, the paper by Dr. T. Proctor Hall, on "The Principles of Electrotherapeutics," and the paper by Professor S. Schatsky, on "The Ionic Theory as Biological Basis for the Therapeutic Action of Electricity," were read.

TUESDAY, SEPTEMBER 13.

On the morning of Tuesday, September 13, the sections met at 9 o'clock and disposed of a number of papers. In Section A, papers were read by Professor Moise Ascoli, on "Systems of Electric Units;" by Dr. H. S. Carhart and Professor G. W. Patterson, Jr., on "The Absolute Value of the Electromotive Force of the Clark and Weston Cells." Another paper was read by Dr. Frank A. Wolff, on "The So-called International Electrical Units." The section entered into a lively discussion of the propriety of adopting certain modifications of the fundamental units. The opinion of the majority of those taking part in this discussion was to the effect that this was an inopportune time for making any changes.

Sections A and D held a joint session to listen to the papers by B. J. Arnold and Charles P. Steinmetz, on the theory of the alternating-current motor. The paper by Herr Max Deri, on single-phase motors, was read by W. I. Slichter, and the papers by M. Latour and by Dr. O. S. Bragstad were read by Professor Steinmetz. P. M. Lincoln read his paper on "Transmission and Distribution Problems Peculiar to the Single-Phase Railway System," and a paper by Dr. F. Niethammer, on "Alternating *versus* Direct-Current Traction," was read by title.

Section C held a joint meeting with the American Electrochemical Society, and disposed of a number of papers. Among these was the paper by Dr. W. D. Bancroft, on "The Chemistry of Electro-Plating," and that by Professor L. Karlenberg, on "The Electrochemical Series of the Metals."

In Section D, the papers by J. S. Peck, on "The High-Tension Transformer in Long-Distance Power Transmission;" by Mr. Smith; by F. A. C. Perrine, on "The American Practice in High-Tension Line Construction and Operation," and by Professor F. G. Baum, on "High-Potential Long-Distance Transmission and Control," were read.

In Section G, the papers by Patrick B. Delaney, on "Rapid Telegraphy;" by Dr. L. M. Potts, on the printing telegraph; by Colonel Samuel Reber, on "The Military Use of the Telephone, Telegraph and Cable;" by John Hesketh, on "A New Danger to Lead-Covered Aerial Telephone Cables," and by F. J. Dommerque, on "The Telephone Problem in Large Cities," were read. The papers by J. C. Barclay, on "Modern High-Speed Printing Telegraph Systems;" by M. Lori, and by Kempster B. Miller, on "The Automatic *versus* the Manual Telephone Exchange," were read by title.

In Section H there were several interesting papers read. Among these, one by Dr. Carl Beck, on "Recent Advances in Roentgen-Ray Science," and one by Professor Dr. M. Benedikt, on "A Contribution to the Radio-Diagnostics of Diseases of the Head and of the Brain," may be mentioned.

On Tuesday afternoon a special display of moving pictures of the works of the Westinghouse companies was given at the Westinghouse companies' auditorium.

In the evening a reception was given at the Italian National Pavilion by the Associazione Elettrotecnica Italiana.

GOOD FELLOWSHIP AMONG THE ENGINEERS.

ABSTRACTS FROM THE ADDRESSES DELIVERED AT THE RECEPTION TO THE FOREIGN ENGINEERS.

The following abstracts have been taken from the addresses delivered on the occasion of the reception tendered by the American Institute of Electrical Engineers at the Waldorf-Astoria, New York city, to the visiting delegates to the International Electrical Congress, Monday evening, September 5:

In his address of welcome on behalf of the Institute Bion J. Arnold, president, said in part:

"Those of us who had the pleasure of being entertained by the Institution of Electrical Engineers, of Great Britain, in 1900, will never forget the many courtesies extended to us and the thoroughness with which we enjoyed them. Our trip on the Thames, our journey with our hosts from London to Paris, our joint meeting at the American Pavilion, our reception by our hosts at the Victoria House, are still fresh in our memories, and many friendships then made will continue during our lives. It is therefore with especial pleasure that we welcome you, President Gray and the members of the Institution of Electrical Engineers. May you take back with you as pleasant recollections of your visit here as those which every one of us brought away with us. To you, President Ascoli and members of the Associazione Elettrotecnica Italiana, and to you, Herr von Siemens, individually and as the representatives of the engineers of Europe, we extend a most hearty welcome."

Professor Moise Ascoli, president, spoke as follows for the Associazione Elettrotecnica Italiana:

"In the memorable days we have passed since our arrival in this country, we have already had occasion to highly appreciate the great hospitality of our American colleagues, and we are sure that the hearty friendship, the warm and sincere and affectionate sympathy with which we have been welcomed, the kindnesses of every sort we have already received from our old and new friends, will leave in our hearts and in our minds a deep and everlasting impression which will undoubtedly have the most important results in our work, in the mutual sympathy between the electrical engineers of the two countries.

"I am very glad to see here so many representatives of three of the most important electrical societies, having the common interest and purpose of increasing the knowledge in the field of electrical science and its application. They are working, I dare say, in parallel, and working in parallel in spite of the laws of electrical engineering they will succeed in raising the potential so as to reach the most unexpected distances."

On behalf of the Institute reception committees, John W. Lieb, Jr., president-elect, American Institute of Electrical Engineers, and chairman of the general reception committee, said:

"It is not a purely professional welcome that we extend to you all, for we feel sure that you will receive everywhere the same bounteous hospitality which is always extended in such a large measure to American engineers when they visit foreign lands. We extend to you, therefore, the right hand of good-fellowship, and desire to make you all feel at home among us, and forget, for the time being, that little strip of water which is all that separates our homes, for the science in whose service we have enlisted knows no political boundaries, but has bound the peoples together with its bonds of steel and of copper and now even the ether, through the genius of our brethren, is made to render service in bringing us yet closer together."

For the Institution of Electrical Engineers, Robert Kaye Gray, Esq., president, responded:

"Ladies and gentlemen, I may say that this visit of our institution to this country arose to a great extent from the fact that we had the great pleasure of receiving your Institute while you were passing on your way through England to Paris. You were good enough to come over and spend, we can only say, too short a time amongst us. I can not say any more than to thank you most cordially, indeed, for the reception you have given us."

In behalf of the American electrical industries, Mr. C. A. Coffin, president of the General Electric Company, Schenectady, N. Y., welcomed the visitors. He emphasized the feeling of amity which existed between the different races represented at this reception, and paid a high tribute to the engineering skill which each country had developed. For his part, he wished it understood that the electrical industry realized the duty which it owed to such a body of men. These men, it is true, were engineers, but they were also scientists in the highest sense of the word. They had been trained not in war nor in diplomacy, but in seeking the truth and establishing it. Without their aid the mere work of the manufacturer would be trivial.

The response for electrical engineering in Europe was made by Mr. Wilhelm von Siemens, of Berlin. Mr. von Siemens spoke in German, and his remarks were translated into English by Mr. L. J. Magee. He said that, after an absence of eleven years, on coming back to America one sees great changes in the country, particularly in the high buildings and the greatly improved facilities for traffic; but the Americans and their characteristics remain the same. These characteristics, above all, are generosity and hospitality. The Americans have been given a great deal, but it has not been given to them for nothing. What they have received has not lain idle, but has been well utilized. All of the great nations of the earth are striving for high developments, and are working in common. For this reason there is no envy of the success of the American colleague.

THE NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.

ANNUAL CONVENTION HELD IN ST. LOUIS, MO., SEPTEMBER 14-16.

The annual convention of the National Electrical Contractors' Association attracted a large number of business men of the country to St. Louis. The convention days were September 14, 15 and 16, but a number of the prominent contractors had taken passage on the special convention train from New York city and other points, so as to arrive in St. Louis in time for the opening sessions of the International Electrical Congress.

Twenty gentlemen and ladies of the National Electrical Contractors' Association reached St. Louis on the special car attached to the Southwestern Limited, *via* the New York Central and Big Four lines. The party was joined *en route* by the president of the association, Mr. Ernest McCleary, of Detroit, Mich., and by the secretary, Mr. W. H. Morton, of Utica, N. Y. At Mattoon, the train was boarded by a delegation of the local St. Louis reception committee, consisting of Mr. W. T. Jackson, of Cincinnati, and Messrs. Adain, Cook, Van Nort and Sutter.

The following representatives of electrical manufacturing interests were passengers on the special train: John Dale, the Dale Company, New York city; H. B. Kirkland and T. H. Bibber, of the American Circular Loom Company, Chelsea, Mass.; V. C. Gilpin, of the De Van Telephone Manufacturing Company, New York city; C. Flack, American Conduit Manufacturing Company, New Kensington, Pa.; J. W. Brooks, Pass & Seymour, Solvay, N. Y.; Norman McCarty, American Diesel Engine Company, New York city; Hugo Reisinger, New York city; W. S. Sisson, D. & W. Fuse Company, Providence, R. I.; C. E. Corrigan, H. G. Osburn and Calvin B. Roulet, Osburn Flexible Conduit Company, New York city; F. W. Harrington and G. W. Swan, John A. Roebling's Sons Company, Trenton, N. J.; J. B. Olson, India Rubber and Gutta Percha Insulating Company, Yonkers, N. Y.; Alexander Henderson and Robert Lundell, Sprague Electric Company, New York city; E. G. Bernard; C. S. Jennings, Sawyer-Man Electric Company, New York city.

The representation from the cities of Chicago, Detroit, Cincinnati, Pittsburg, Milwaukee, Philadelphia and Boston was large. The Jefferson, Washington, Southers and Planters' hotels were largely filled with those attending the electrical meetings.

The early part of the week was mainly spent in sight-seeing at the exposition. The business sessions of the convention were well attended, and the additional attractiveness which St. Louis presents at this time was the means of bringing together an exceptionally large number of prominent contractors throughout the country.

The Convention of the Street Railway Association of the State of New York.

The Twenty-second Annual Meeting of the Street Railway Association of the State of New York Was Held at Utica, N. Y., on Tuesday and Wednesday, September 13 and 14, 1904.

FROM the point of view of number of attendants, papers and enthusiasm the convention of the Street Railway Association of the State of New York, held at Utica, September 13 and 14, was a memorable one. Regrets were read from a number of prominent men who were unable to be present.

The delegates were welcomed by Mayor Charles A. Talcott. The courtesies of the local telephone and trolley lines were extended to all delegates, free of charge.

The president of the association, E. G. Connette, of Syracuse, in his address sketched briefly the history of the street railway, especially in the Mohawk valley. He reviewed the handling of freight by electric lines, a rapidly growing source of revenue for trolley companies, and spoke of the use of electricity by the New York Central lines as the beginning of the movement to supplant steam lines.

The report of the secretary and treasurer showed the society to be in a sound financial condition and gaining members.

The paper of Mr. M. G. Starrett, chief engineer of the New York City Railway Company, on "Power Production and Distribution on the Metropolitan Street Railway System," was read by Mr. W. B. Reed. After a description of the plan of the system the arguments which induced the company to use alternating current instead of direct current, by which $650,000 was saved, were given.

Substations carry batteries with a capacity of twenty-five per cent of that of the rotary converters, which help at the peak load and smooth fluctuations. The efficiency of the whole system is seventy-six per cent.

Mr. C. E. Roehl, of the Brooklyn Heights Railroad Company, led in the discussion and gave a brief description of his plant. He finds it cheaper to build substations than to maintain long, low-tension feeders, and cheaper to send direct current out of substations than out of main power-houses. The Brooklyn Heights company does not find need for storage batteries.

Mr. H. H. Vreeland, of the Metropolitan Street Railway system, considers the distribution of power one of the most important problems in electric traction. He finds batteries essential for New York conditions, an eighteen-hour day.

Mr. T. E. Mitten, general manager of the International Traction Company, Buffalo, using Niagara falls power, finds a great saving in using batteries; three-fourths of the purchased current being stored part of the day.

The second paper was by Mr. H. A. Benedict, of the United Traction Company, of Albany, on the "Maintenance of Electric Cars and Their Equipment." He discussed types of equipment in relation to requirements and the need of new and modern car houses, preferring concrete construction. The repair shop, storeroom, inspection and lubrication were also treated. For a lubricant Mr. Benedict prefers oil to grease.

In the discussion Mr. R. E. Danforth suggested a thorough daily inspection, with complete overhauling after four months.

Mr. Mitten has not had satisfactory results from storage of cars outside of houses. Mr. W. W. Cole, of Elmira, finds the kilowatt output to vary with the temperature, hence does not approve of outside storage. Mr. W. B. Reed and Mr. H. Rockwell also entered into the discussion.

At the close of the morning session the following nominating committee was announced: Messrs. H. H. Vreeland, W. C. Ely, G. T. Rogers, J. N. Shannahan and H. J. Clark.

At the opening of the afternoon session the report of the committee on rules for the government of conductors and motormen was presented by Mr. T. E. Mitten. The attempt in formulating these rules was to make them conform as nearly as possible with the standards of the American Railway Association. A vote of thanks was extended to Mr. C. R. Barnes, state railroad commissioner, for his aid to the committee.

"Freight and Express Business on Street Railways," by Mr. C. R. Van Etten, general freight agent of the Brooklyn Rapid Transit Company, treated the conditions influencing the advent of electric traction lines into the express business.

Mr. L. E. Serrell, consulting engineer of the Oneonta, Cooperstown & Richfield Springs Company, treated "The Question of Freight" from the standpoint of traffic connections largely with steam roads. He thinks it is necessary to organize a freight traffic association among electric railroads.

Mr. George Dunford, general express agent of the Utica & Mohawk Valley Railway, described "A Method of Handling Interurban Express Matter," and submitted a series of blanks used by him for this purpose.

In the discussion of these three papers Mr. Sanderson, of the former Metropolitan Express Company, found express business at local rates in New York did not pay, due chiefly to inability to ally with old companies to advantage. He found steam railroad methods best for freight service.

Mr. H. A. Robinson considers the arrangement of a contract protecting companies from fire damage a great necessity.

The report of the committee appointed to investigate the dangers incident to high-voltage power transmission lines, at the request of the state railroad commissioners, was read by Mr. S. B. Storer. It was voted to continue the work of the committee for another year.

At the close of the afternoon session members were taken in private cars to a suburban substation where some of the tests of the above committee were repeated.

On Tuesday evening a banquet was held at the Masonic Temple. It was well attended and thoroughly enjoyed. Mr. John D. Kernan, as toastmaster, called upon Messrs. George E. Dunham, H. H. Vreeland, Addison B. Colvin, W. W. Cole and others who responded in happy vein.

The Wednesday morning session was opened with Mr. J. B. Struble's paper on "Block Signaling of Electric Railways with Track Circuit Control," read by Mr. W. W. Cole. Alternating current is used, and the signal is carried by means of the return rail. Excess of direct current only sets the danger signal. There are many designs and types of signals, the function of all being to indicate danger only. The paper is a partial description of the system used in the New York subway.

Mr. W. B. Potter, electrical engineer, railway department, General Electric Company, Schenectady, N. Y., described the perfected commutator motor which had so successful a trial a few weeks ago. A full description of this compensated single-phase motor and its operation was published in the ELECTRICAL REVIEW

for August 27. The necessary apparatus had been installed in the Oriskany substation on the Rome line of the Utica & Mohawk Valley system. Trolley wires had been suspended, in addition to the regulation feeders, and the tests were made with the special car of the General Electric Company between Rome and Oriskany. This car was brought to Utica and placed in service on the interurban lines, so that the delegates might have an opportunity to witness these tests, under the direction of Mr. Potter.

The paper by Mr. W. J. Davis, Jr., entitled "Relative Economy in the Operation of Long and Short Cars," closed the list.

The data compiled by Mr. H. M. Beardsley, auditor of the Elmira Water, Light and Railway Company, on the minimum population necessary to make interurban railroads pay, and the paper, "The Relation of the Technical School to the Business and Profession of Electric Railways," by Professor H. H. Norris, of Cornell University, Ithaca, N. Y., were not read on account of the lack of time.

The question box developed some interesting discussion. This took up such topics as power-station equipment, track construction, overhead line construction, the selection of rolling stock, block signal systems, accidents, car-houses, employés, interurban fares, amusement parks, repair shops, snow problems, traffic development, and wheels.

Following the reading and discussion of the papers, officers were elected for the ensuing year, as follows:

President, C. Loomis Allen, Utica; first vice-president, J. H. Pardee, Canandaigua; second vice-president, A. B. Colvin, Glens Falls. Executive committee, E. G. Connette, Syracuse; R. E. Danforth, Rochester; B. B. Nostrand, Jr., Peekskill; E. F. Peck, Schenectady. Secretary, W. W. Cole, Elmira.

THE EXHIBITORS.

The manufacturers made a fine display of street railway supplies. Among those exhibiting electrical apparatus and accessories were the following:

Earl Trolley Retriever Company, New York, N. Y.

Atlas Railway Supply Company, Chicago, Ill.

Erie Trolley Wheel Company, Erie, Pa.

Paul Reeves & Son, Philadelphia, Pa.

Security Register Company, New York, N. Y.

Recording Fare Register Company, New Haven, Ct.

American Automatic Switch Company, New York, N. Y.

The Pennsylvania Steel Company, Steelton, Pa.

National Brake Company, Buffalo, N. Y.

Ohio Brass Company, Mansfield, Ohio.

Gold Car Heating and Lighting Company, New York, N. Y.

Consolidated Car Heating Company, Albany, N. Y.

Scranton Bolt and Nut Company, Scranton, Pa.

Wheel Truing Brake-Shoe Company, Detroit, Mich.

The Van Dorn Elliott Electric Company, Cleveland, Ohio.

Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.

H. P. Crouse, Utica, N. Y.

Utica Fire-Alarm Telegraph Company, Utica, N. Y.

National Electric Company, Milwaukee, Wis

Hale & Kilburn, New York, N. Y.

Yale & Towne Manufacturing Company, New York, N. Y.

Crouse-Hinds & Company, Syracuse, N. Y.

Downward Light Electric Company, New York, N. Y.

American Iron and Steel Manufacturing Company, Lebanon, Pa.

The O. M. Edwards Company, Syracuse, N. Y.

The Curtain Supply Company, Chicago, Ill.

The Duff Manufacturing Company, Pittsburg, Pa.

Federal Manufacturing Company, Elyria, Ohio.

O. J. Childs Company, Utica, N. Y.

Shanahan Trolley Specialty Company, Little Falls, N. Y.

Garton-Daniels Company, Keokuk, Iowa.

Continuous Rail Joint Company of America, Newark, N. J.

Railway Steel-Spring Company, New York, N. Y.

C. S. Knowles, Boston, Mass.

Ohmer Fare Register Company, Dayton, Ohio.

Eureka Automatic Signal Company, Sanford, Pa.

Sterling Meaker Company, Newark, N. J.

New York Leather Belting Company, Brooklyn, N. Y.

William Lintern, Cleveland, Ohio.

Johns-Manville Company, New York, N. Y.

Ludlow Supply Company, Cleveland, Ohio.

Brady Brass Company, Jersey City, N. J.

Suspension Ferries.

Suspension ferries for crossing rivers where a strong current interferes with regular ferryboats or where there is considerable traffic are very popular on the Continent. One over the Loire river at Nantes, France, possesses some new features of construction and uses electricity as a motive power. Traffic enters the bridge directly from the street and at the same time vessels in the river are not affected in the slightest.

The structure consists of two steel towers joined by a horizontal suspension bridge 490 feet long and 165 feet above the water, anchored by cables. A steel carriage from which the car is suspended by steel cables travels along rails on the bridge. Two stationary motors on the left end of the bridge develop the power for moving the carriage. The car has a capacity of thirty tons dead weight and makes the trip in one minute. The average power necessary for operation is ten horse-power, but the motors have a capacity of twenty-five horse-power on account of occasional violent winds. A similar ferry is being built at Newport, England.

Visit of the British Civil Engineers.

Sir William White, formerly chief naval constructor of the British navy and president of the Institution of Civil Engineers, arrived on Saturday, September 10, from Liverpool aboard the Cunarder Etruria. He was accompanied by 100 other members of the institution, all of whom will be the guests of the American Society of Civil Engineers during their stay in this city. After a week's visit the principal cities of the United States and Canada will be visited, attention only being given to the most important public and private works. The New York entertainment was opened on September 13 by a reception at the house of the American Society. On Friday evening a banquet was given at Delmonico's.

Additional Revenue for a Street Railway.

The Brooklyn Rapid Transit Company adds considerably to its revenue by carrying dogs on its cars. Season tickets are issued quarterly, for which a charge of twenty-five cents is made. The presentation of this ticket entitles the owner to carry the animal on the cars. The company carries an average of two thousand dogs a month and realizes an income from this of about five hundred dollars.

The Mechanical and Electrical Equipment of the Hotel Astor.

WHAT is said to be the finest hotel in the world was recently opened to the public in New York city. This is the Hotel Astor, situated on the west side of Times Square, between Forty-fourth and Forty-fifth streets. The location is, in many ways, excellent, being practically at the centre of the transportation systems of the city, and within the theatre district. The building was erected by Mr. William Waldorf Astor for Mr. William C. Muschenheim, and it alone represents a cost of about $5,000,000. The ground is valued at more than $1,000,000, and the movable furniture cost about $700,000, a total cost of about $7,000,000.

The hotel covers an area of 35,000 square feet, is ten stories high, and contains over 500 bedrooms, dining-rooms and a kitchen capable of serving 3,500 persons at one time, a ballroom and banquet-room where 1,300 can be accommodated, a smaller ballroom and a number of suites designed for special occasions

On the first floor, at the Times Square entrance, is a large, handsomely decorated lobby. To the right, on the Forty-fifth street side, are the ladies' reception and dining-rooms, and on the Forty-fourth street side are the gentlemen's dining-rooms and billiard-rooms. The former are finished in marble and gold, and the latter in oak, with a frieze representing hunting scenes. In the rear of the lobby, entered by a corridor, is the orangery. This takes up the whole space under two large courts. It is 104 feet by 75 feet, and is a reproduction of an Italian garden.

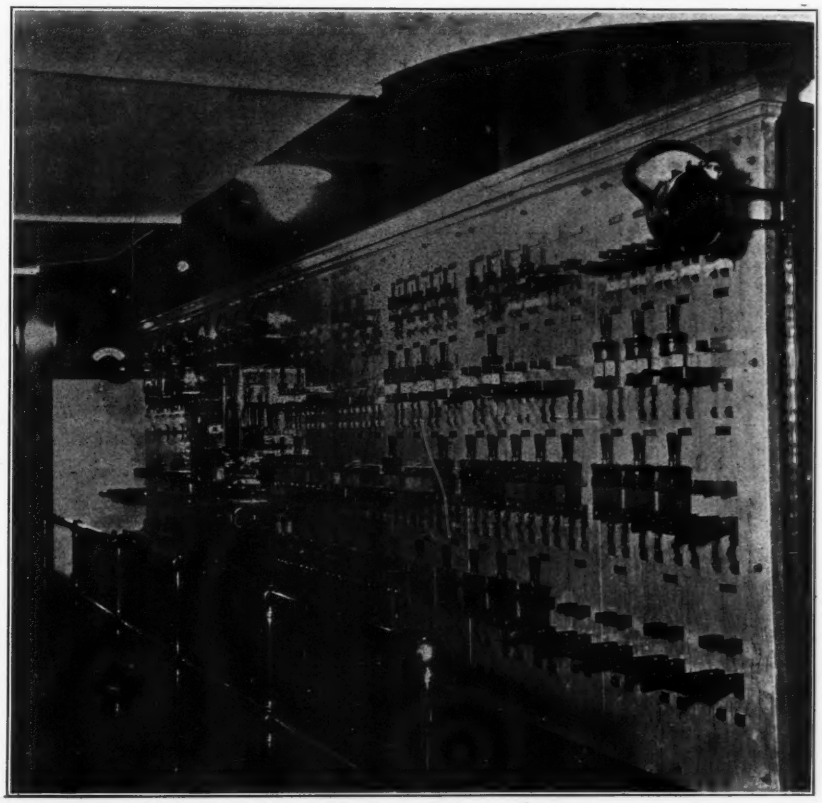
The seven floors above the ground floor are practically alike, although the most elaborate suites are on the second floor. There are over 500 bedrooms on these floors.

The ninth floor has at the front a ballroom, and extending from this along the Forty-fourth street side is a series of private dining-rooms, which can be opened into one another. On the Forty-fifth street side of the house there is a large banquet or ballroom, and a small kitchen.

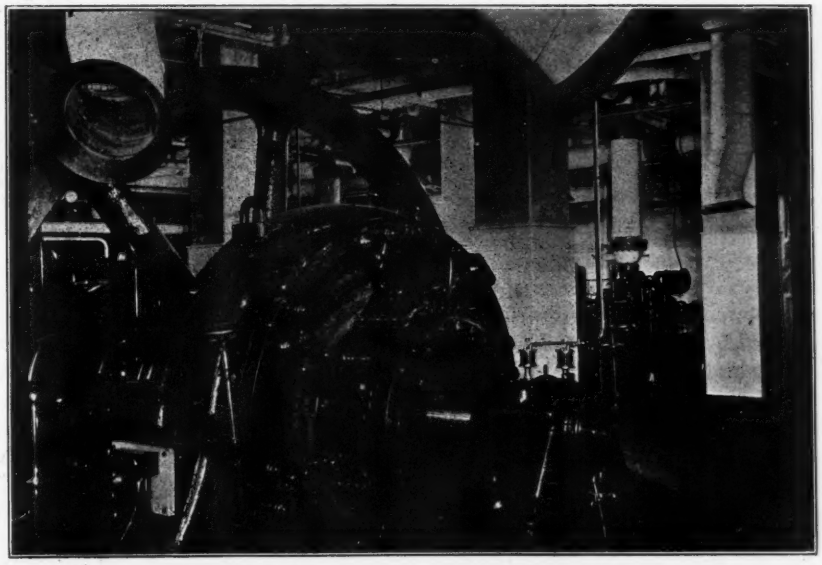
On the tenth floor are quarters for the servants and the laundry, and on the roof there are beautifully arranged gardens and promenades.

In decorating this magnificent hotel, and in furnishing it with every comfort for its guests, electrical appliances play an important part. There are six electric elevators, giving ready access to any part of the building. The kitchen is connected with the various floors and the dining and banquet-rooms, by automatic electric dumbwaiters. In each room the electric lighting has been made to harmonize with the decorations, many of the fixtures being very elaborate and beautiful. This is particularly true of the orangery, where the general lighting by concealed lamps is an imitation of the sky, while drop lights, representing various fruits and flowers, are hung from the pergola overhead.

Each bedroom has a telephone for local or long-distance connection, and, in addition, a call system of neat construction This is operated by the usual push-button, but at the main office a small incandescent lamp is lighted and a buzzer



SWITCHBOARD IN THE POWER PLANT OF THE HOTEL ASTOR, NEW YORK CITY.



VIEW IN THE ENGINE ROOM, HOTEL ASTOR, NEW YORK CITY.

sounds, the signal there being similar to that used in modern telephone switchboards. Each bedroom has also an automatic temperature regulator, by which the occupant can set to keep the temperature of his room at any desired point. There is also, throughout the entire building, a fire-alarm system which gives warning at the main office when the temperature at any point rises above 130 degrees.

The fire-protection system is very elaborate. The building itself is a model of the most recent development of fireproof construction. Experience has shown that the greater number of deaths from fire are caused by suffocation, and not by the flames or heat; therefore, the building was designed so as narrowly to confine a fire which might be started. Each floor is isolated from the others by fireproof enclosures around the stairways and elevators, and each floor is further divided into sections. Should an alarm come in to the office from any point, the attendant, by moving a lever, closes all the doors to these sections, without, however, locking them, thus confining any fire and smoke to its source.

To light and heat this building, and to run the machinery, an elaborate power plant is required. This is placed in the subbasement, below the kitchens and the wine vaults, and here is found machinery which would constitute a very respectable power plant for a small town. The building is heated by exhaust steam from the large engines driving the generators, and wherever possible power is drawn from the latter to drive the machinery of the hotel by means of electric motors.

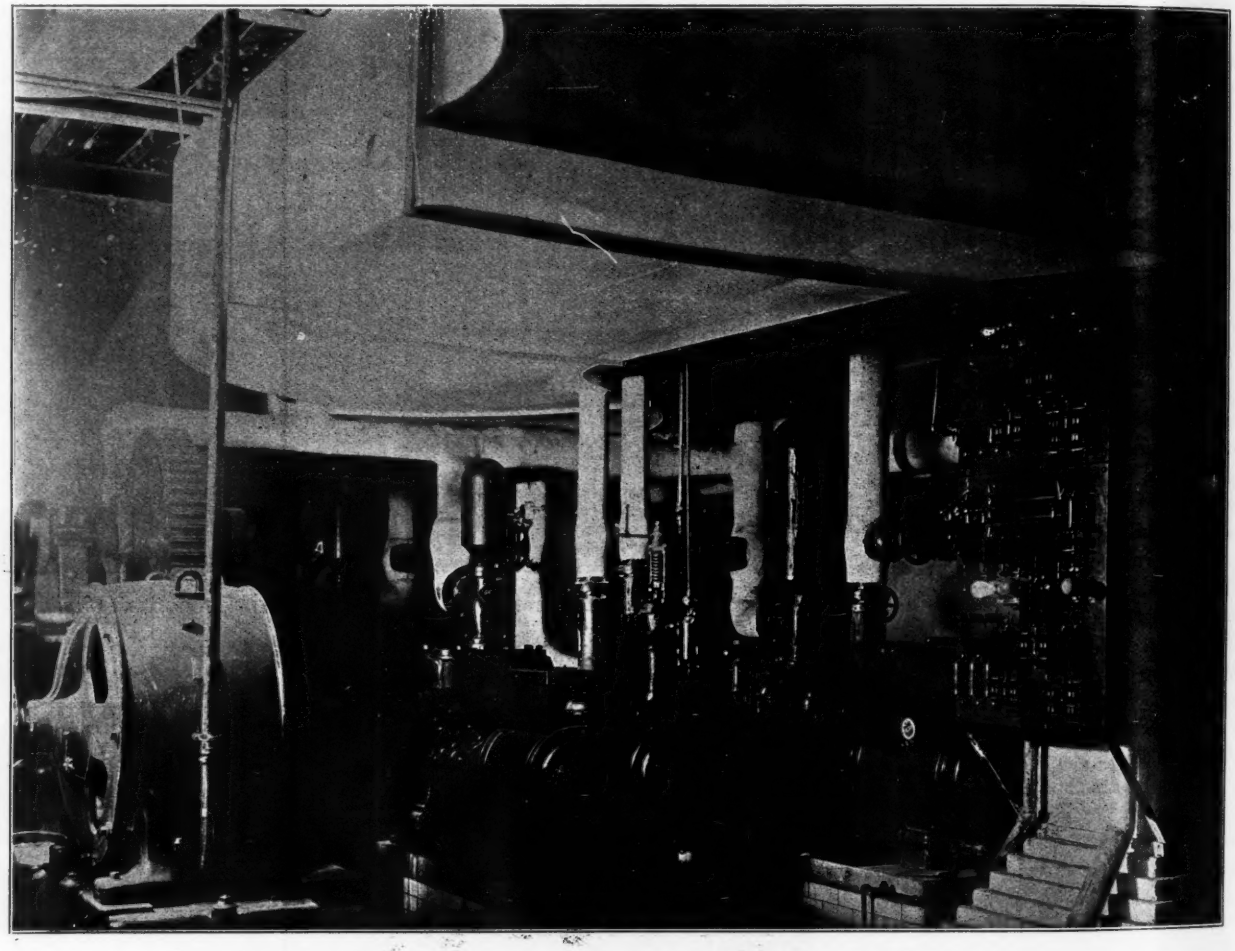
Steam for running the plant is furnished by four Babcock & Wilcox boilers, placed in the rear of this basement. Coal for the boilers is delivered from carts entering a driveway from the street for this purpose into a coal bunker with a capacity of 300 tons, whence it is put into small cars and carried to the boilers. The latter are provided with superheating coils and are designed for 200 pounds pressure. They will probably work at about 150 pounds steam pressure, superheating 500 degrees.

Adjacent to the boiler-room is a garbage destructor which will dispose of all waste. This has a capacity of six tons, or 50,000 cubic yards. It was specified that it should be able to cremate garbage containing seventy-five per cent of water, the coal for this purpose not weighing more than one-tenth as much as the garbage.

Adjoining the boiler-room is the refrigerating apparatus. Here all the pumps are in duplicate, one set being driven by motors, the other set by steam. This equipment consists of two high-pressure brine pumps, two low-pressure brine pumps and two ammonia pumps.

An interesting little economy has been adopted at this point. The cooling water from the ammonia compressor is not allowed to waste, but is further heated and used as the hot-water supply for the house. Both the hot and cold-water service systems are operated by pumps, also in duplicate, one set being driven by electric motors, and the other set by steam pumps. In addition to this machinery there are four boiler-feed pumps and two air compressors, half driven electrically and the other half by steam.

The engine-room contains four tandem-compound Corliss engines built by the

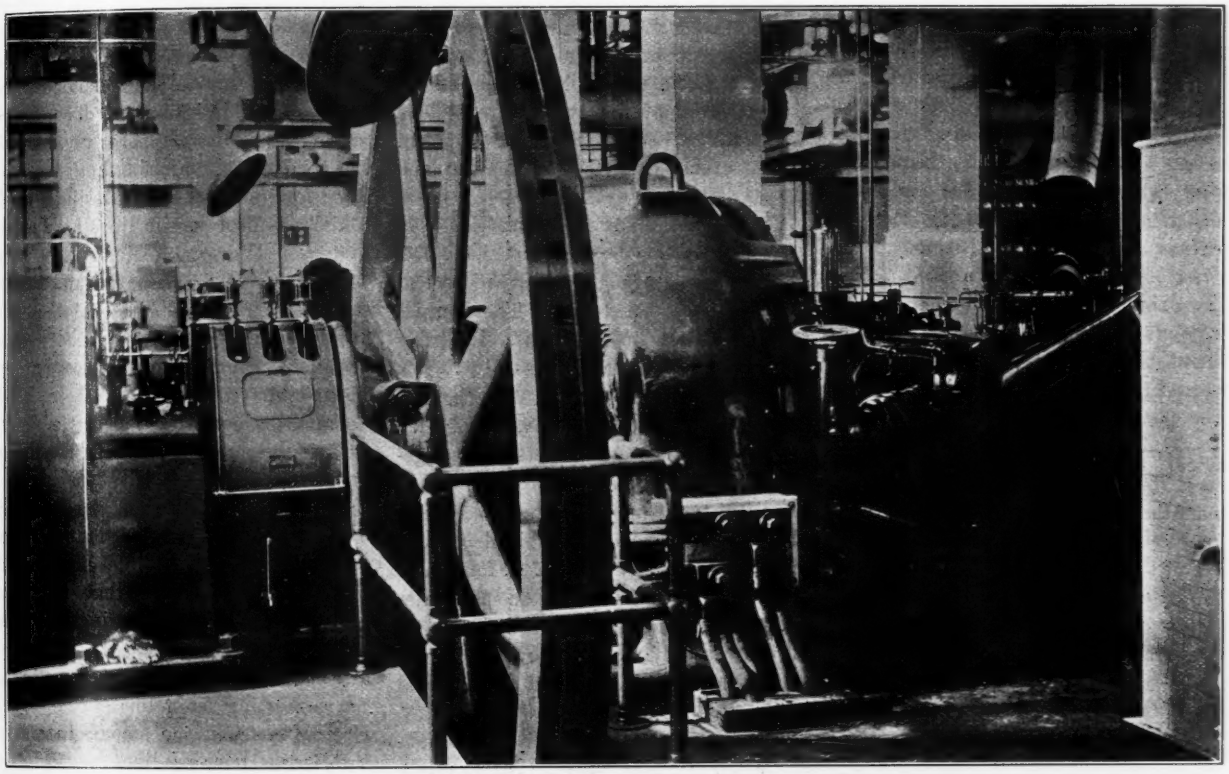


ELECTRIC AND STEAM PUMPS, AND CONTROL BOARD, HOTEL ASTOR, NEW YORK CITY.

Providence Engineering Works, and direct-connected to four 250-kilowatt Western Electric generators. These units run at 120 revolutions per minute, the engine cylinders being fourteen and twenty-four inches in diameter, with a stroke of forty-two inches. Each engine has a fourteen-foot flywheel, in addition to the generator armature. The generators are eight-pole machines, and operate at 120 volts. They are compound-wound.

At the south side of the engine-room pumps are started first by connecting them across a sixty-volt circuit, which is obtained by taking a tap out of the middle of the storage battery. After they have attained full speed at this voltage, they are thrown over on the main system, which is maintained at 120 volts, and they then run up to their normal speed. In starting by hand, it is only necessary to turn a small arm. This, by operating a number of magnetic switches, first cuts out the starting resistance, then weakens the motor field, changes over from the 60 to the 120-volt system, at the same time reintroducing the starting resistance and the full field strength; then the starting resistance is again cut out, the fields are weakened a second time, and the motor finally reaches its operating speed. A small magnetic brake, attached to the starting lever, prevents the latter from being turned too rapidly, and thus protects the motor and avoids unnecessary fluctuations of the system.

The service pumps and the boiler-feed pumps are started in the same way, except that the starting is automatically controlled, a regulator of the Ford type starting and stopping them as the system may require.

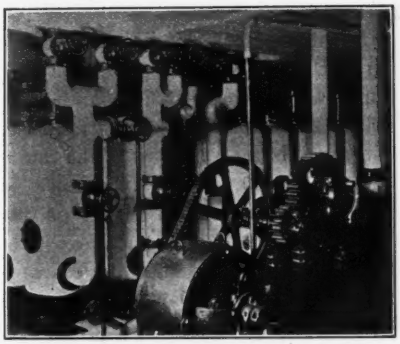


General View of Engine Room, Hotel Astor, New York City.

is a handsome marble switchboard having panels for the generators, a storage battery, two boosters used in connection with the battery, and for the various distributing circuits. The storage battery room is immediately in the rear of the switchboard, and is entirely enclosed. This battery has an output equal to that of one of the generators, and it plays an important part in steadying the voltage of the system and in starting the motors, as will be explained later.

For charging the battery there are two boosters, as mentioned, one a small shunt machine with a capacity of seventeen and one-half kilowatts, and the other a thirty-kilowatt differential booster.

The pump motors are controlled by two methods. The greater number are started by hand, while there are several started automatically, the latter being the house pumps and the boiler-feed pumps. The



Condensing Apparatus, Electric Pumps in Foreground.

Other points where motors are employed are in operating the elevators, dumbwaiters, in the kitchen, where the dish-washers and knife-scrubbers, etc., are driven electrically, and in the laundry, where all the machinery is motor driven.

The ventilating system is one of the most important features of the hotel. Large electrically driven fans aggregating 250 horse-power circulate the air throughout the building and supply cool air to the kitchen and dining-rooms, and draw off the heated air.

The arrangements for serving the dining-rooms promptly are most complete. Orders received are transmitted by pneumatic tubes to the kitchen. These are filled in the kitchen, the dishes are placed on electric dumbwaiters which can be set to stop at any floor, and when this point is reached, the door is automatically unlocked, and a signal sounds until it is

opened. When a dumbwaiter is required at any floor, it is only necessary to push a button, and the waiter will come to that floor and stop. Dishes, which are washed in the kitchen by electrically driven washers, are then taken to an electrically driven conveyer, which distributes them.

In the engine-room, no pains have been spared to secure regular and quiet operation. There is a complete lubricating system, water filters and heaters. The motors operating pumps drive by means of a Morse chain. The engines are fitted with Monarch stops which prevent any accident from excessive speeds. Under normal conditions, three engines will be in operation, the fourth being held in reserve. There is, in addition the storage battery which equalizes the load and forms an important reserve. The engine-room has been finished in harmony with the rest of the hotel, and forms an interesting exhibition. It can be viewed by the guests of the hotel from a glass-enclosed observation gallery which projects into the room.

The power plant is in entire keeping with the rest of the hotel. It is undoubtedly one of the largest—if not the largest—and most complete hotel installations that has ever been erected. It was designed by Mr. F. A. Muschenheim and Colonel J. Hollis Wells. The building was designed by Messrs. Clinton & Russell, of New York city, and was built by Mr. John Downey, of the same city. The contract for the steam plant was let to Messrs. Baker, Smith & Company, and the greater part of the electrical apparatus was furnished by the Western Electric Company, Chicago, Ill. The storage battery was installed by the Electric Storage Battery Company, Philadelphia, Pa.

Civil Service Examinations for the State and County Service.

The State Civil Service Commission announces general examinations to be held October 8, 1904, including the following positions: assistant civil engineer; assistant in biology and histology, cancer laboratory; electrical engineer, state architect's office; heating engineer, state architect's office; inspector, state board of pharmacy; library assistant in sociology, state library; messenger, state and county offices; assistant state geologist, marine engineer.

Examinations for court stenographer will be held in Albany, Buffalo, New York and Syracuse in October and November.

Applications for these examinations must be made on or before October 3. Full particulars of the examinations and blank applications may be obtained by addressing the chief examiner of the commission at Albany.

The Telephone in England.

In the fiftieth annual report of the British postmaster-general the telephone situation is dwelt upon at some length. The total length of the trunk circuits in use at the end of March of this year was 51,400 miles, containing 102,800 miles of wire. The capital outstanding on the purchase and development of the trunk wire system up to the same time was $11,000,000, including an expenditure during the year of $540,000. The department has been authorized to raise the sum of $15,000,000 for the development of the telephone system of the country. Of this, $6,500,000 will be required for the extension of the trunk wire system, and about $8,500,000 for the development of the exchange system in London and the provinces.

The total number of trunk line conversations during the year was 13,467,975, the corresponding figures for the preceding year being 11,574,229. The increase for the year was 16.3 per cent. The gross revenue from this service was $1,627,625, an increase of 18.4 per cent over the preceding year. The average value of each conversation was 11.6 cents. Arrangements have been made whereby conversations on the Anglo-French and Anglo-Belgian circuits can be obtained between the hours of 9 P. M. and 7 A. M. for double periods of six minutes for the same rates as for conversations of three minutes during the day, by callers who contract for one or more calls each night for a period of at least one month.

Experiments which have been conducted during the year with a view to establishing telephone communication between England and Holland show that it is not at present practicable to construct a cable at reasonable cost which will enable direct communication to be established and maintained satisfactorily.

The number of telephones in connection with the post office London telephone system increased during the year from 9,122 to 15,632, and additional subscribers are being connected at the rate of from 100 to 200 a week. Three new exchanges have been opened during the year. The combination at the central exchange will be nearly exhausted in the course of the financial year 1904-1905. The construction of a second exchange with a maximum capacity of 18,000 lines is in progress. The length of underground pipes which had been laid in London on March 31 last was 1,146 miles. Cables containing 125,717 miles of wire have been provided.

Electric Transportation in Germany.

This year is the twenty-fifth anniversary of electric traction in Germany. At the Berlin trade exhibition in 1879, Siemens & Halske, of Berlin, operated an electric locomotive on a circular track about 1,000 feet long. The road was opened on May 31 of that year.

The progress made since then is shown in recent statistical reports covering the development up to October 31, 1903. At that date there were 134 main centres (cities or districts) for electric roads. The total mileage was 2,308, and the total length of single track was 3,438 miles. There were 8,702 motor cars and 6,190 trailers in operation. The overhead trolley system is in general use. Dresden has a mixed system, using both the trolley and accumulators. In Berlin, Dresden and Dusseldorf certain lines have conduit systems. The accumulator system is used on one line at Bremerhaven and in Palatinate, but it is expected that these lines will be changed to some other systems within a short time. There are only about thirty-three miles of track still operated by horse traction in Germany.

But little progress has been made in the substitution of electricity for steam on branch railroads during the past year. Five per cent of these branches have so far been converted into electric roads, though it is reported that these have made such favorable showings that more changes will follow shortly. There are also some projects under consideration for converting main line steam roads to electric systems, one among these being the Berlin-Hamburg line.

A Correction.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In a paper I read before the National Electric Light Association, at Boston, in May, reference was made to the use of the 220-volt lamp in St. Louis. I made the statement that the installation at St. Louis in 1899 was made under the engineering advice of Mr. Bion J. Arnold. Mr. H. H. Humphrey, of St. Louis, advises me that the recommendations covering the adoption of the 220-volt lamp in the installation in question were made by Messrs. Bryan and Humphrey in September, 1897, and that the system was installed under their direction as supervising engineers. In view of these facts, I would be pleased to have you publish this correction.

WALTER I. BARNES.

Providence, R. I., September 9.

[The article referred to is entitled "A Three-Wire 500-Volt Lighting System," and was printed in the issue of the ELECTRICAL REVIEW for May 28, 1904.—ED.]

TRANSFORMER TESTING FOR CENTRAL STATIONS—I.[1]

BY S. E. JOHANNESON.

The successful operation of an alternating-current lighting plant is largely dependent upon the transformer. It is the medium through which power is delivered to the customer, and should be capable of giving continuously the highest quality of service and at the same time be economical in operation.

Generally speaking, transformers do not receive the attention in testing and operation which their importance justifies. There are comparatively few power plants which carry on systematic transformer testing. This is probably due to scarcity of information on transformer testing and to lack of necessary testing apparatus.

A more universal practice of station testing will give safer and better service, increase station earnings and establish a truer competitive basis for the commerce of transformers.

In operation the transformer has practically the same characteristics as the generator. If its insulation is weak or its working temperature high, it is dangerous to both life and property, and its early failure will cause a temporary and perhaps permanent stoppage of part of the station earnings. If its regulation is poor, customers become dissatisfied. If its losses are high, it increases the operating expenses.

The performance figures given in commercial literature of the various makes of transformers built in the United States are practically the same. In many cases, however, the actual operating figures differ from the advertised values by more than fifty per cent. The lack of testing has protected and nourished misrepresentation, and the slightly lower prices sometimes quoted have created a market for inferior goods.

The purpose of this paper is to give the various tests which may be applied to transformers. These are:

Ratio, polarity—preliminary tests.

Temperature, insulation—determining continuity of service.

Resistance, impedance, regulation—determining quality of service.

Iron loss, copper loss, efficiency—determining economy of operation.

Tests enumerated above are usually applied before transformers are shipped from the factory; therefore, for ordinary station practice all of the tests need not be applied to each unit installed.

It is necessary to apply the ratio and polarity tests only on those transformers which are to operate in parallel. However, owing to the simplicity of these tests, it is recommended that they be made on all transformers installed, so that in case of emergency where rapid installation is required, transformers may be connected in parallel without further testing.

The insulation, owing to its important bearing on personal and fire risks, and the iron loss, on account of its variability in similar transformers, should be tested on each transformer. Since temperature, resistance and impedance values are practically the same in similar transformers, it is not important that these tests be applied to each unit installed. Two of every lot of ten or fifteen transformers of the same size and style are sufficient.

Accurate results depend on several conditions. To avoid appreciable error in testing the following points should be observed:

Conductors used in test should have sufficient cross section to carry the maximum currents employed. They should also be as short as permissible. As a precautionary measure against accident, the conductors used, as well as all connections, should be well insulated.

The selection of instruments having the proper scale and capacity is essential. With the exception of current dynamometers, all instruments give the most satisfactory readings anywhere between approximately the twenty-five and eighty-five per cent points of the scale.

Instruments should be calibrated before being used, or should be known to be correct.

In observing instruments the line of vision must be at right angles to the plane of the instrument. The scales of some instruments are provided with mirrors, by means of which the above conditions are determined. When the needle and its image are coincident the line of vision and the plane of instrument are at right angles.

In tests where more than one instrument are employed, and where the current is drawn from a commercial circuit (which usually varies in voltage), observations must be made simultaneously. In some tests accuracy depends upon rapidity of adjustment and observation.

The source of error due to variable voltage may be approximately eliminated by taking several readings. For practical purposes, however, not more than four or five observations are necessary. Wrong frequency will produce error, especially in iron loss and impedence tests. Corrections may be made if exact frequency is known.

Protection of Instruments—In order to protect instruments, the testing circuits should always be properly fused. The fuse should be of sufficient capacity to carry safely the currents to be measured, but should never exceed the capacity of the ammeter. It should be connected in the relative locations shown in the diagrams. As a general rule the carrying capacity of open fuses exceeds their rated capacity by approximately fifty per cent.

Relating to Records—Preparing for a test should include the preparation of a record sheet with the necessary rulings and headings, so that when tests are being made the values obtained need only to be entered. The serial number and make of each instrument should always be recorded, so that in case of necessity it will be possible to refer to the instrument. Plotting of test values in form of curves is recommended wherever measurements permit. It is a valuable aid in studying and comparing test results.

RATIO AND POLARITY TESTS.

Before a multi-voltage transformer is either tested or put in service (whether it is to operate separately or in parallel) it must be connected for the right high and low tension voltages. Diagram of connections usually sent with transformers give connections for the various voltages which may be obtained. Many burnouts are due to wrong connections.

The ratio of a transformer should be correct, otherwise the quality of service will be unsatisfactory to the customer, because the delivered voltage will be too high or too low. Low voltage gives unsatisfactory light, and high voltage reduces the life of the lamp, thus creating higher light and lamp renewal bills.

Correct ratios are also essential for the parallel operation of transformers, otherwise cross currents will be circulated through windings, which in any case has a damaging effect.

A further condition to be fulfilled before transformers may be operated in parallel is that they must be of the same polarity; that is, the instantaneous direction of current in terminals joined must be the same.

Every alternating-current power plant should be provided with a transformer of which the exact ratio and polarity is known. This transformer should be used in testing ratio and polarity of other transformers.

Refer to Fig. 1, where c is the central

[1] Paper read at the tenth annual convention of the Ohio Electric Light Association, Sandusky, Ohio, August 16.

point of a single-pole, double-throw switch and to which one of the voltmeter terminals is connected; p the open secondary terminal of the potential transformer, and s the open secondary terminal of the transformer under test are connected to the poles of the switch. Secondary terminals s' of the transformer under test

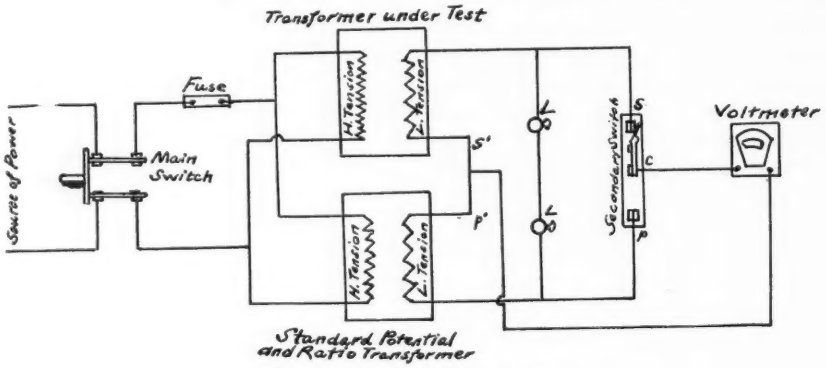


FIG. 1.—RATIO AND POLARITY.

and the primary terminal p' the secondary of the potential transformer, are both connected to the common voltmeter lead; L, L, are two incandescent lamps in series across the terminals p and s of the transformer, for use in determining polarity. Each of these lamps should be provided with a key, so that they may be easily cut in or out of circuit. In the diagram the primary of transformer under test is in parallel with the standard ratio and polarity transformer. Their secondaries are in series.

Procedure of Tests; Polarity—Connect as shown. With secondary switch open and lamps in circuit, close main switch. If lamps light up, polarity of transformers is the same.

Ratio—Next cut out lamps, close secondary switch, first across s and then across p. Read voltages. The voltage across p and p' is the primary voltage reduced by the ratio of standard transformers.

TEMPERATURE TEST.

The measure of worth of a transformer is its ability to give continuous service, and this depends largely on low-operating temperature. The report of the standardization committee of the American Institute of Electrical Engineers specifies temperature rise for transformers as follows:

For intermittent or continuous service, temperature rise by thermometer fifty degrees centigrade, by resistance forty degrees centigrade.

Temperature test, specified for intermittent service, is the application of full load for three hours after maximum open circuit temperature has been attained.

There are two general methods in use for determining the operating temperature of a transformer.

The actual method where the transformers are delivering full load under actual working conditions. This method is always expensive (unless the power delivered can be utilized). When transformers are of any size it is generally impracticable.

The differential method, shown in Figs. 2 and 3, where the actual energy used does not exceed the total losses of both transformers under test.

Differential Method; Case 1—In this method separate circuits A and B supply, respectively, the iron and copper loss energy to the low-tension side of the transformer. The ammeter measuring the copper loss current is located in the high-tension side. The purpose of the auxiliary transformer is to lower the voltage to the value required to produce full-load current in the windings.

Procedure of Test—Estimate values to be measured. Voltages of transformers are given in diagram of connections or marked on case. The current equals the rated watt capacity divided by the rated voltage. Trial voltages to produce full-load current in standard lighting trans-

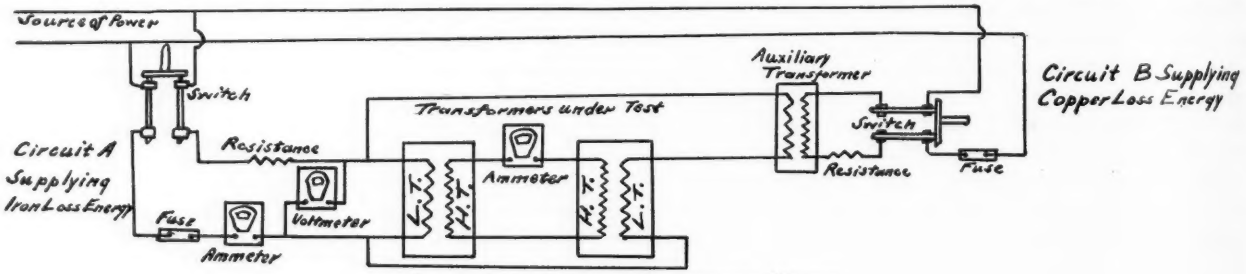


FIG. 2.—TEMPERATURE—DIFFERENTIAL METHOD.

formers may be taken, as given in impedance test.

Procedure of Tests—Select instruments. Connect as in Fig. 2. With switch of circuit A open, close switch of circuit B, adjust voltage so that full rated tension

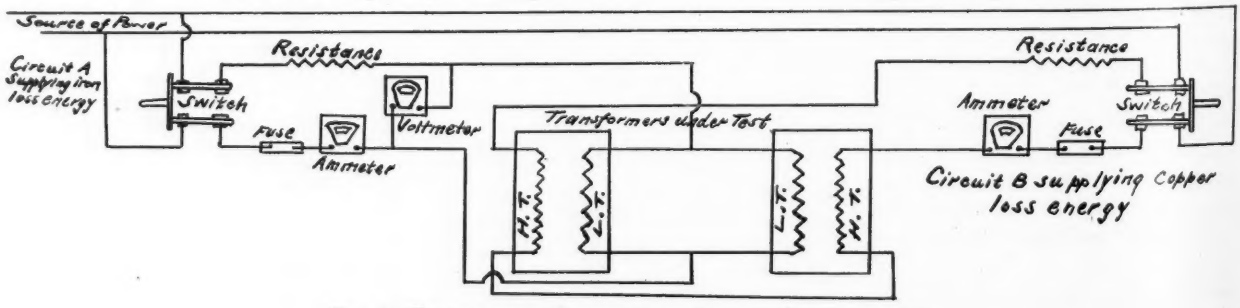


FIG. 3.—TEMPERATURE—DIFFERENTIAL METHOD—MODIFIED FORM.

current of one transformer is registered on primary ammeter. Next close switch of circuit A and adjust voltage to rated potential of secondary of one transformer. While this is being done the rated full load current must be maintained.

Differential Method; Case 2—Refer to

Fig. 3. Where it is difficult either to obtain or handle the large current or low voltage necessary when supplying the copper loss energy to the low tension side of transformers of large capacity, this method (which is a modified form of the differential method shown in Fig. 2) may be employed. It is largely in use since the proper adjustments of current and voltage are more easily obtained. The procedure of test is the same as that given in Differential Method, Case 1.

When the iron loss pressure is applied to low tension terminals in Differential Method, Cases 1 and 2, the pressure across the high tension terminals is the full rated voltage of the transformer, hence care should be taken in reading ammeter in the primary circuit. Since the current measured by this ammeter (which should be constant throughout the entire run) is adjusted on the low tension side, it may be set for values to be measured before power is switched on, thus avoiding any further handling of that instrument.

If thermometers are used to measure temperature they should be screened from local air currents and placed so that they may be read without being removed.

As the transformer becomes heated, drop in current and voltage takes place, therefore while temperature run is in progress the initial current and voltage should be maintained. The instruments, especially the voltmeters, should be connected so that they may be readily switched out of circuit as soon as measurements are made.

The temperature rise by resistance gives the average rise throughout the windings of the transformer. To obtain average temperature rise of each of the windings, separate resistance readings should be taken of each.

The thermometer indicates temperature at the point where it is applied. The usual method of ascertaining the room temperature is to read it directly from thermometers suspended near apparatus under test, and this is sufficiently accurate for practical purposes where the room temperature is approximately constant throughout the test.

Before test is started, transformers should be left in the room a sufficient length of time for them to be affected alike by the room temperature.

If it is desired to obtain temperature curve, thermometer readings should be taken at half-hour intervals throughout the test and until difference between room temperature and that of transformer is constant. The resistance measurements of transformers under test should be taken at approximately three-hour intervals until they become stationary. While resistance measurements are being made, all switches should be open.

In order to shorten the time required to make a temperature run a load greater than normal full load is applied. In the practice of this method, care should be taken not to allow the temperature of windings to exceed eighty-five degrees centigrade.

Relating to temperature rise of electrical apparatus, the report of the Standardization Committee of the American Institute of Electrical Engineers specifies that it must be referred to a standard room temperature of twenty-five degrees centigrade, and that a correction of one-half per cent per degree must be made for any variation from that temperature, adding if less and subtracting if more.

The temperature rise by increase of resistance may be determined by the use of temperature co-efficient, forty-two per cent per degree from and at zero degrees.

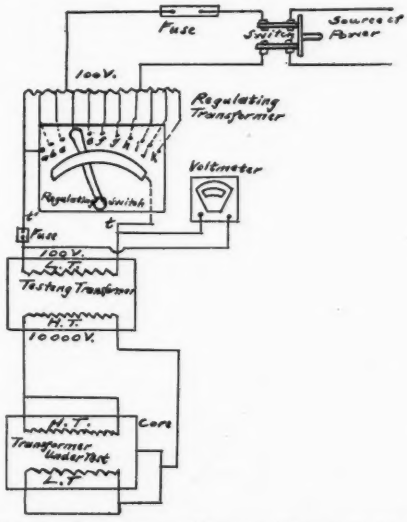


FIG. 4.—INSULATION—TESTING TRANSFORMER.

Considering the above rules the temperature rise corrected to twenty-five degrees may be determined as follows:

Case A, where temperature is measured by thermometers.

Example: Let ultimate temperature of apparatus be sixty degrees centigrade and room temperature twenty degrees centigrade. Determine corrected temperature rise.

In this example the apparent temperature rise is 60−20=40° centigrade, but since the room temperature is five degrees lower than the standard requirements, a correction of ½+5=2−½ per cent must be added, giving a corrected temperature of $\frac{102.5 \times 40}{100} = 41°$ C.

Case B, where temperature of apparatus under test is measured by increase of resistance.

Example: The initial primary resistance of transformer under test is 8.5 ohms, and at its maximum operating temperature, 9.75 ohms. Temperature of room during test, thirty degrees centigrade. Determine corrected temperature rise.

In this case the initial resistance, which is taken at a temperature of thirty degrees centigrade when referred to temperature co-efficient of .42 per cent per degree represents a rise of 30+.42=12.6 per cent above its value at zero, and which is $\frac{8.5 \times 100}{112.5} = 7.549$ ohms. The final resistance of 9.75 ohms represents a rise of $\frac{(9.75 - 7.549)\,100}{7.549} = 29.16$ per cent above value at zero, and equivalent to $\frac{29.16}{.42} =$ 69.43° C. ultimate temperature. Deducting from this the room temperature at thirty degrees the apparent rise =39.43° centigrade. Now since temperature of room during test was five degrees above standard requirements, a correction of ½ × 5 or 2 − ½ per cent must be subtracted, giving a corrected rise of $\frac{39.43 \times 97.5}{100} = 38.44°$ C.

INSULATION TEST.

The first thing essentially required of a transformer is that it shall be capable of delivering power without risk to life or property. The National Board of Fire Underwriters specify that "the insulation of transformers when heated shall withstand continuously for five minutes a difference of potential of 10,000 volts (alternating) between primary and secondary coils and the core and a no-load run of double voltage for thirty minutes."

The insulation tests applied to Westinghouse transformers designed for 2,000-volt service are as follows:

Insulation Tests—Between high tension and low tension with latter grounded to core and case, 10,000 volts for five minutes.

Between low tension and core and case, 4,000 volts for five minutes.

Over-Potential Test—A no-load run at double potential for thirty minutes and triple potential for five minutes.

It is highly important that insulation tests be made on every transformer installed. Since these tests have been made in the factory, it will be sufficient to apply momentary insulation tests at the plant.

The usual apparatus required to test

insulation is: a testing transformer, a regulating transformer, a regulator dial and a voltmeter.

Refer to Fig. 4, where the testing transformer is represented as being wound for

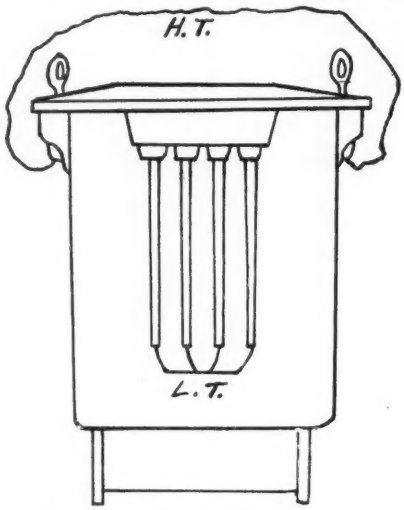


FIG. 5.—TRANSFORMER TERMINALS.

100 volts on primary and 10,000 volts on secondary. The regulating transformer is an autotransformer with taps brought out so as to receive currents at 100 and transform from twenty to 200 volts, in steps of twenty volts.

The testing transformer should, preferably, have low inductance, so that the variation in voltage, due to leading and lagging currents, will not be large. The potentials of such a transformer will be practically in the ratio of the turns, and the high-tension voltages may be determined by measuring the low-tension voltage and multiplying by ratio of transformation.

The capacity of the fuse in circuit should be slightly greater than the idle currents of both transformers when they are operating at highest inductions, so that, if a break occurs across the insulation of the transformer under test, the fuse will immediately blow. A fuse should also be inserted in primary circuit of testing transformer. In applying insulation tests, it is necessary that all the terminals of each of the primary and secondary windings be connected as shown in Fig. 5. Portions of the windings not connected to the testing transformer will be subjected to induced stresses which may even exceed the applied voltages. For the same reason, when testing between primary and secondary, the latter should be grounded to core and case.

The use of a spark-gap is not recommended on account of the great static stresses to which both the testing transformer and the transformer under test are subjected when arcs occur across gap.

In cases where the testing transformer has high inductance and where an electrostatic voltmeter for directly measuring the high-tension voltage is not available, the spark-gap may be used.

The table below gives spark-gap distances in dry air between needle points. Whenever needle points are used, they should be renewed after each discharge.

NEEDLE POINTS.

Volts.	Sparking Distance.
5,000.....	0.225 inches.
10,000.....	0.47 "
15,000.....	0.725 "
20,000.....	1.0 "
25,000.....	1.3 "
30,000.....	1.625 "
35,000.....	2.0 "
40,000.....	2.45 "
45,000.....	2.95 "
50,000.....	3.55 "

Procedure of Insulation Test—Connect as shown in Fig. 7. With terminals of testing transformer connected to terminals of transformers under test and with regulator switch in position *a;* close main switch; increase voltage slowly by means of regulator switch until the required primary potential is registered on voltmeter. Before the main switch is opened, the regulator switch should be turned back in position *a.*

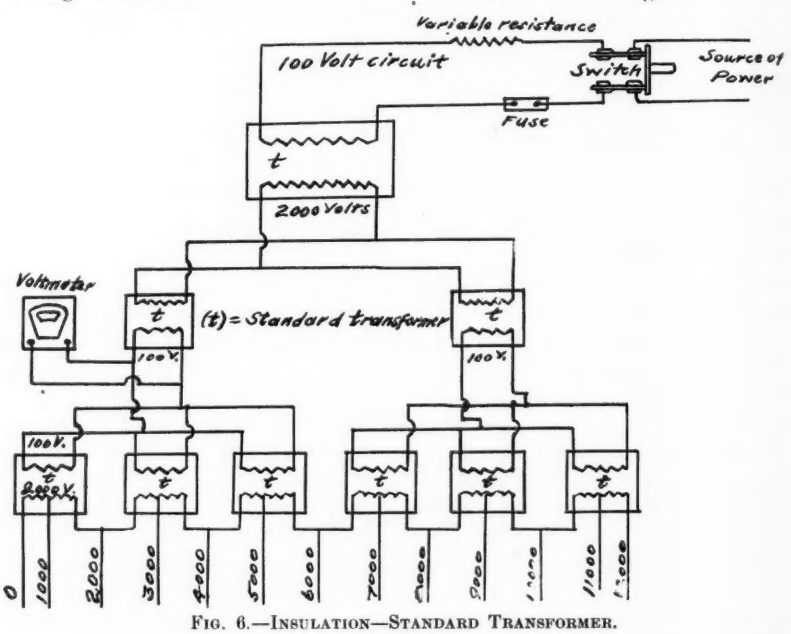


FIG. 6.—INSULATION—STANDARD TRANSFORMER.

Over Potential Test—In applying the over potential test, the exciting current of a transformer is always increased. This increase will depend on induction at which transformer normally operates. The exciting current should never be allowed to exceed the full load current of transformer.

In general, this test should be applied at higher frequency, so that the exciting currents may be reduced. It is recommended that sixty-cycle transformers be tested with 133-cycle currents and twenty-five-cycle transformers with sixty-cycle currents.

The over potential voltages may be applied direct to high-tension terminals of transformer under test. It is generally more convenient, however, to apply it to low-tension side by connecting the transformer to be tested for 100 volts and apply 200.

Procedure of Over Potential Test—Connect secondary of transformer under test for 100 volts, then to *t* and *t'*, terminals of regulating transformer. Then proceed as in insulation test.

In case a testing transformer, or any other apparatus as described above, is not available, the high potential voltages for insulation tests may be obtained by connecting a bank of standard lighting transformers as shown in Fig. 6.

Transformers shown in diagram are 1,000, 2,000/100, 200 volts. It will be noted that they are grouped in two banks and each group fed by separate circuits. This method of connection limits the strain to which the insulation of transformers employed are subjected (by reason of their high tension being connected in series and low tension in parallel) to 6,000 volts.

RESISTANCE.

Resistance of electrical conductors may be determined by several different methods, the most common of which are the Wheatstone bridge and fall of potential methods. In cases of low resistances, such as are found in the low-tension side of standard lighting transformers of ca-

pacities greater than four-kilowatt it is extremely difficult to obtain accurate results. The most satisfactory method in use is the fall of potential method.

As will be seen by the connections in Fig. 7, both the voltmeter current and current applied to transformer under test are measured by the ammeter. This introduces an error which in magnitude will be in the ratio of the voltmeter resistance to the transformer resistance. The error, however, is readily corrected, as shown below.

Select instruments of such capacity and scale as will give good readable deflections. The current values to be used in determining resistance should never exceed the rated current values of the transformer, and should preferably be less than three-fourths of this value.

The resistance may be found within a wide range of current and voltage values, and the values to be employed will depend largely upon the instruments at hand, especially the voltmeters.

The higher the resistance to be measured the more accurate and reliable the results obtained. It is therefore preferable to connect each of the high and low-tension taps in multivoltage transformers for the highest resistance, that is, for the highest-rated voltage.

The current and pressure values for resistance measurements may be predetermined as follows:

Rated full load currents—

$$\text{H. T. amperes} = \frac{\text{Rated capacity of transformer}}{\text{Highest rated H. T. voltage}}$$

$$\text{L. T. amperes} = \frac{\text{Rated capacity of transformer}}{\text{Highest rated L. T. voltage}}$$

The approximate fall of potential at rated full load currents in each of the windings of standard lighting transformers, ranges from one to one and one-half per cent.

Procedure of Test—Connect as shown, with voltmeter circuit open at contact button. Close switch. Vary resistance until desired current is obtained. Close voltmeter circuit, read both instruments simultaneously. Open voltmeter circuit; open switch; record values.

The power for this method should preferably be drawn from storage batteries, but may be taken from a direct-current generator.

Variable resistance should preferably be the ordinary standard resistance grids or rheostats found on the open market, but may be a bank of incandescent lamps so arranged that they may be easily connected in series or multiple, in order to vary the current strength.

Before resistance measurements are made, the temperatures of windings of transformers should be constant throughout. A thermometer indicating the temperature of the transformer should be so placed that it may be read without being removed.

The voltmeter should not be in circuit when power is switched off or on, or while the current adjustments are being made.

Several readings at different current and voltage values should be taken. Immediately after each reading the power should be cut off. It is extremely important that measurements be taken as rapidly as possible, especially if the current is near the full load values on account of heating up the conductors, and it is equally important in all cases that the voltmeter needle be absolutely at rest before the observation is taken, otherwise the values obtained will not be reliable.

Resistance may be determined by ohms law. $\text{Resistance} = \frac{\text{Volts}}{\text{Amperes}}$.

Results obtained should always be corrected to standard temperature requirements of twenty-five degrees centigrade.

If the temperature of the coils is different for each observation, then the resistance must be calculated for each and the average taken. If the temperature of the coils is the same for all observations, then the average current and voltage may first be determined and the resistance calculated from the average values.

Example: The average current and voltage values in resistance measurements of a coil are two and ten, respectively. The resistance of the direct-current voltmeter used in tests is 400 ohms. Temperature of coil under test is thirty degrees centigrade. Determine corrected resistance.

Current taken by voltmeter at ten volts is $\frac{10}{400} = .025$ amperes. Actual current in coil $= 2 - .025 = 1.975$ amperes. Resistance of transformer coil at 30 degrees centigrade is $\frac{10}{1.975} = 5.08$ ohms. The resistance at twenty-five degrees centigrade referred to temperature co-efficient of .42 per cent per degree from and at zero degrees centigrade is $\frac{100 + (.42 \times 24)}{100 + (.42 \times 30)}$ $5.08 = 4.98$ ohms.

(To be continued.)

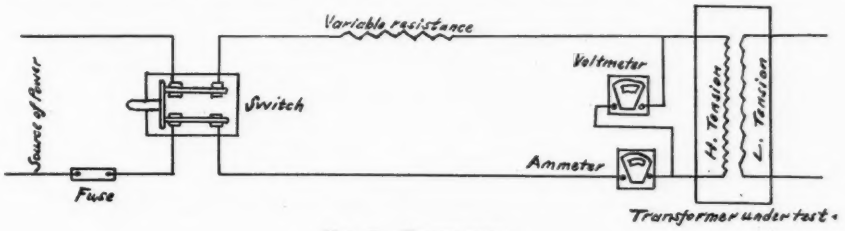


FIG. 7.—RESISTANCE.

Rubber for Paving Purposes.

In May, 1902, after twenty years of continuous service, the rubber pavement laid in 1881 on the roads under the hotel at Euston station, London, was removed. It was found that the pavement had worn very well. Originally two inches in thickness it was worn down to from five-eighths of an inch to one and one-quarter inches, the thinnest points being where the horses first entered the paved strip. The chief advantage of rubber for paving purposes is that it is noiseless, the cost being about thirty-three dollars per square yard, making it almost too expensive for ordinary purposes.

Correspondence by Telephone.

An excellent scheme for business men who have considerable correspondence, but who hardly require the constant services of a stenographer, has been evolved by a Cleveland man. By means of a telephone exchange and a private system, his patrons telephone their correspondence to a number of competent and rapid stenographers, who receive the material and reproduce it on the typewriter. In this way six stenographers are said to be able to handle the morning correspondence of forty business men in all parts of the city.

Telegraph and Telephone Progress in Russia.

Considerable activity has been shown during the present year in the development of the telegraph and telephone in Russia. One million nine hundred thousand rubles were appropriated for the construction of new lines, about one-fourth of which has been devoted to telephone and the remainder to telegraph construction. Seven hundred million rubles were expended in establishing telegraphic communication along the Trans-Siberian railroad.

Sixteen-Mile 80,000-Volt Experimental Line.

At the recent meeting of the Pacific Coast Electric Transmission Association, held at Monterey, Cal., an interesting paper was read by Mr. A. C. Balch, describing the work of an experimental transmission line at 80,000 volts. Early in 1903 it was recognized that the then proposed Kern river transmission line, which was to be 125 miles in length and to deliver at its terminals 10,000 horsepower, working at a voltage of 45,000 at the power-house, would not develop all the water power available about the Kern river. The desirability of increasing the voltage of the system was recognized, and the president of the Pacific Light and Power Company, Mr. W. G. Kerckhoff, instructed that a test should be made of the various types of insulators obtainable, with a view to determining the highest practical voltage. A line sixteen miles in length, consisting of three wires, with forty inches between wires, was started up on April 1 and kept under test until June. All sorts of weather was experienced during this time. One night four inches of rain fell through all of the country in which the line was built. There was an average of 80,000 volts between two of the wires and the third wire. Only single-phase transformers were available, and these were two 40,000-volt transformers which were connected in series, with the centre between the two grounded. Two of the wires were connected to one of the outside terminals of these transformers, and one to the other. The ammeter showed no apparent tendency to become inoperative on account of static charge. The current to the line was approximately three amperes. This did not fall more than five per cent at any time during the test. The size of the wire was No. 4 B. & S. gauge.

When the line was in operation a sharp, rattling sound was in evidence, which seemed to be localized at points along the wire, varying from one-pole length to a half-pole length, but could never be placed. At times it seemed as though objects extending out from the ground, such as neighboring trees and poles, made greater noise apparent in their locality. This sound could be easily heard 100 yards from the line at any time. A reduction of twenty per cent in voltage practically stopped all the noise.

On a dark night the line was luminous, and could be seen on any night if between the observer and a dark object. It presented the appearance of a stream of bluish light about three inches in diameter for each line. It did not show any nodes or extra brilliant points. There was no extra intensity of brilliancy at the insulators or any other place, except at the tie-wire on the top of the glass insulators, where the luminous volume seemed to be enlarged. The single wire, however, was considerably brighter than the other two. The telephone line, which ran six feet below the other cross-arm, was charged so that half an ampere could be drawn from it through 100 ohms. When either of the telephone wires was on open circuit, a spark four inches long could be drawn from it to the ground. In spite of this, the telephone was easily used. There was no difficulty in measuring the current on the line during any sort of weather.

The tests show that the line, as constructed, operates satisfactorily as long as the insulators are new or during any period when they are free from dust. No difference was experienced between wood and iron pins, and in no case did the current short-circuit from the wire over the insulators to the pins. The experiment led the Pacific Light and Power Company to adopt a large insulator made of brown porcelain, in four pieces, and arranged so that it is easily wiped clean. It is intended that at least once a year the insulators shall be cleaned by hand, in order to remove all dust. It is believed that 66,000 volts can then be used without giving any difficulty whatever.

The New Telephone System at Hopkinsville, Ky.

One of the most recent independent installations is that of the Hopkinsville Home Telephone Company, at Hopkinsville, Ky. The ultimate capacity of the plant is 10,000 subscribers, the first installation being an equipment for 700 subscribers. All of the central office equipment has been furnished and installed complete, and turned over to the Hopkinsville company ready for operation. At the present time the company has 500 subscribers connected.

The power-board is a handsome marble panel equipped with Weston ammeter and voltmeter arranged for taking readings on the various circuits. There are overload and under-load circuit-breakers for the storage battery charging circuit, and the necessary knife switches, tubular fuses, regulating resistances, etc. There are two storage batteries of the American Battery Company's type, each battery consisting of twenty-seven 100-ampere-hour cells. The charging machines are of the Holtzer-Cabot Company's make, and are in duplicate. They are designed to run from a 110-volt, 133-cycle, single-phase, commercial power circuit. The ringing machines are also made by the Holtzer-Cabot Company. One of these is a one-sixth-horse-power machine designed to operate on the commercial power circuit, and the other is a one-sixth-horse-power Holtzer-Cabot machine designed to be run from one of the storage batteries.

The cross-connecting frame is of the Cook type, equipped on the switchboard side with heat coils and lightning arresters for 700 pairs, and on the line side with terminal boxes for 1,000 pairs. The protectors are furnished with tell-tale circuits, so that in case a heat coil blows, an alarm is instantly given, calling the attention of the switchboard attendant. The heat coils on the automatic switchboards, and the main fuses on the power-board, are also equipped with the tell-tale alarm.

The telephones for this exchange were furnished by the Automatic Electric Company, Chicago, Ill. The wall instruments are standard-type quarter-sawed oak cabinets, golden finish, and in desk telephones of the regular type.

A peculiar feature of this exchange is the fire-alarm system, which was installed upon the solicitation of the city board of aldermen. The fire-alarm stations and other points interested in fire calls use the regular telephones, and ordinarily call and receive messages in the regular manner. In case of a fire, however, any party, by pulling the figure five on his dial and pushing his button, can ring and talk to all of these interested parties simultaneously, and give the location of the fire. The fire chief can immediately give his orders to his lieutenants without making any calls, because they are all connected to his telephone at this time. After a subscriber has thus sent in a fire-alarm call, it is impossible for him to again use his telephone until the switchboard attendant at the central office has made a record of the number of the party who made the call, and has again thrown the subscriber's apparatus into service. This method of interlocking prevents any malicious ringing of false alarms.

The plant was installed by the Ideal Construction Company, of Lima, Ohio.

The officers of the Home company are: R. E. Cooper, president; G. H. Metheaney, vice-president; J. F. Garnett, treasurer; F. G. Hoge, secretary, and J. T. Edmunds, general counsel, together with directors E. M. Flack, Hon. W. T. Fowler and J. Russell.

THE AUTO-TELEGRAPH CAR.

BY WALDON FAWCETT.

A distinct advance in the field of electrical communication may be said to have been made with the introduction of what is known as the auto-telegraph car, a motor vehicle of unique design which has just been completed to the order of the U. S. War Department. For some time past the administrative officials of the American Army, in common with those of foreign organizations, have been investigating the subject of the possible usefulness of the automobile in warfare, and in accordance with a determination to put the whole matter to a practical test the new auto car herewith illustrated was designed and constructed especially for the use of the U. S. Signal Corps.

Under existing military conditions the chief function of the Signal Corps is found in the erection, maintenance and operation of temporary or permanent military telephone and telegraph lines designed to keep open communication between armed posts or other headquarters and forces in the field, and it is in this service that the new auto will be chiefly used. In order to contribute to its maximum usefulness, the car has been so designed as to not only facilitate the rapid erection of telegraph or telephone lines, but also to serve as a field telegraph station.

The automobile itself is, in design, very similar to a heavy touring car of the Winton type, with the exception that the ordinary style of tonneau has been replaced by a special tonneau with seats along the sides, the occupants of which face each other, and with ample storage space for instruments and other equipment. At the sides of the car are racks on which are carried lances and light poles for use in erecting temporary overhead telephone or telegraph lines when other supports are not available.

[Copyright, Waldon Fawcett, 1904.]

THE SIGNAL SQUAD IN THE FIELD WITH THE AUTO-TELEGRAPH CAR.

[Copyright, Waldon Fawcett, 1904.]

DRILLING WITH THE AUTO-TELEGRAPH CAR. THE SIGNAL SQUAD IN THE FIELD.

So economical has been the allotment of space that the auto-telegraph car is ca-

pable of transporting a surprising amount of equipment. This equipment also has been selected with a view to its mobility. For instance, the Signal Corps is now making use for field lines of a wire so light that a reel of it may be carried in a man's pocket. This "flying" telegraph office is equipped with all the latest improvements in equipment, including "sounders" especially adapted to the receipt and transmission of messages amid the clash of arms or other excessive noise.

The detachment of Signal Corps men who make up the auto squad comprises eight or nine men, including the operator of the automobile and one or two telephone and telegraph operators. The remainder of the soldiers are prepared to serve as linemen, but their main duty is to act as an armed guard for the operators engaged in the transmission of wire communications. Of course, these operators are also armed and prepared to take care of themselves in the event of a brush with an enemy.

Self-Propelled Electric Motor Cars in England.

The first self-propelled electric motor cars for use on a British railway were put into service on Monday, August 8, on the section of the Northeastern line between Scarborough and Filey. These cars are intended to carry short-distance passengers, and to give frequent service. They attain their maximum speed in about thirty seconds, and can be brought to a standstill in a similar time. They can be put into service at ten minutes' notice, and carry a supply of fuel and water for a full day's work. They operate from either end with equal facility. An average speed of twenty miles an hour will be maintained.

International Electrical Exposition to be Held in New York City.

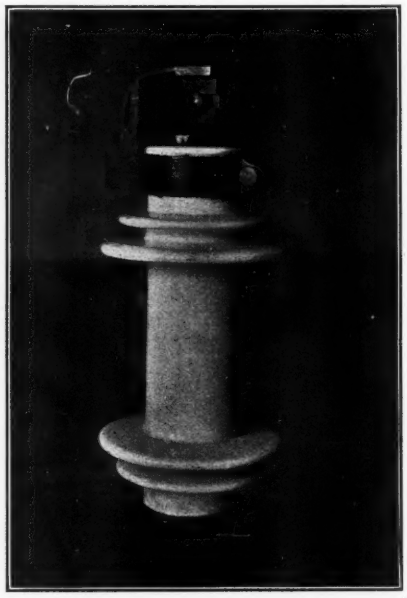
An international electrical exposition will be held, under the auspices of the Electrical Contractors' Association of New York city, at Madison Square Garden, December 19-28, 1904. The executive committee is composed of Joseph R. Strong, chairman; E. S. Keefer, E. K. Comstock, J. P. Hall, J. C. Hatzel, S. Davis and G. W. Russell, Jr. The managing directors are Messrs. Weber & Rush, and the business representative is Mr. M. Spiegel, Madison Square Garden, New York city.

It is the intention to make this exposition exclusively an electrical industrial exhibit. Applications for special privileges must be submitted to the managers not later than December 10, 1904.

FOREIGN ELECTRICAL NOTES.

[From Our Special Correspondent.]

A new type of safety fuse for high tension circuits is now being used in the Pierre de Plan station of Lausaune, Switzerland. This station is one of the largest in the country, and receives direct current over a high-tension line from the St. Maurice hydraulic plant. The appearance of the fuse device is shown in the engraving. It consists of a porcelain tube closed at the bottom and held at each end by an encircling copper piece. The upper piece carries a clamp which holds a silver wire. The wire passes down into the chamber and is fastened to a strong spring, which keeps it stretched tight. The spring is electrically connected with the lower metal piece, so that the current passes between the two pieces and through the fuse-wire. The end caps have H projections which fit into a pair of jaws on the switchboard, so that the device can be removed with ease. The vessel is nearly filled with oil. When the fuse blows, the spring draws the lower part down into the oil and the arc is thus quenched. The director of the station informs the writer that these fuses have been working very well ever since they were installed, and there is no arcing or explosion.



A New Type of Safety Fuse.

Arrangements are already being made for the seventh annual automobile show which is to be held at Paris under the auspices of the Automobile Club, from December 9 to December 25. It will be held as usual in the Grand Palace of the Champs Elyseés and promises to be even a more brilliant affair than last year's show. It is to have a new feature this year which will be of especial interest. In the large Horticultural Building near by is to be organized a special exposition, consisting of the manufacturers of automobiles in different stages. This will, no doubt, prove a great attraction for the public. The committee has already addressed the leading manufacturers to this effect, and some of them have promised to install exhibits of this kind. Most of the leading firms will, no doubt, be represented, and this will make the new part of the show one of the most attractive.

C. L. Durand.

Paris, September 3.

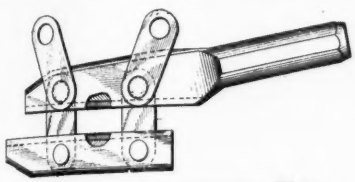
A Municipal Light, Heat and Power Plant for Baltimore.

Subway Engineer Charles Phelps has submitted to Mayor Timanus, of Baltimore, Md., a report upon the cost and the feasibility of establishing a plant to furnish light, heat and power to the municipal buildings. Mr. Phelps points out that while the plant is intended primarily for supplying the municipal buildings, it would also suffice for the piers, the parks and other public places. The location suggested for the plant is in the neighborhood of Hawk street and Jones' Falls, and it is estimated that it will cost $150,000 to $175,000. One feature of the plant will be the elimination from the municipal buildings of all coal-consuming appliances.

The plans for the plant contemplate the installation of 750 horse-power in boilers, and engines and generators capable of delivering 300 kilowatts. The estimate covers the complete equipment of the plant and all the necessary conductors and piping to distribute the steam and power to the buildings. The boiler plant estimated upon has a reserve capacity of fifty per cent above the maximum demand of the generating plant, and has an overload capacity of about 100 per cent. The total estimated cost of operating is given as $23,327, including fuel, station supplies, wages and salaries, and repairs and maintenance. For this sum the plant should give during the year 835,200 kilowatt-hours, the cost being 2.8 cents per kilowatt-hour. Allowing for an additional equipment for dock lighting, this would cost $25,000, and would increase the operating expenses by $5,220, and would increase the demand on the station by 385,920 kilowatt-hours. The total cost of operating the plant, according to the estimate, would be $28,547. The total output would be 1,221,120 kilowatt-hours, so that the cost per kilowatt-hour would be 2.34 cents.

Electrical Patents.

Henry Beaudette, of Troy, N. Y., has obtained letters-patent of the United States, No. 768,974, dated August 30, 1904, for an improved tool for inserting



IMPROVED TOOL FOR INSERTING WIRE IN SLEEVES.

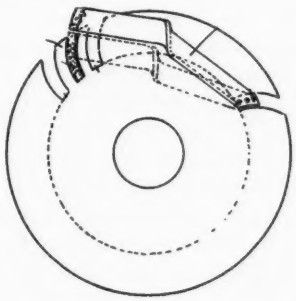
wires in sleeves. This invention relates to devices for use in forcing electric wires into coupling sleeves, the object being to provide a tool for this purpose that will be simple in construction, inexpensive, and by means of which the wire ends may be easily inserted. The tool of the accompanying cut comprises two jaws, each jaw being provided in its inner face with a longitudinal channel, which is substantially V-shaped; the walls are provided with ratchet-shaped teeth. The jaws are connected at one side by means of links, the said links engaging with studs on the jaws. At the opposite side the upper jaw is provided with studs, with which links engage, and these links are also designed to be removably engaged with studs on the jaw. To prevent the links from being wholly removed from the long studs, the ends of the studs are slightly upset or headed. In the operation, the wire is placed in the tool and the end inserted in the sleeve, which is of the usual construction—that is, it has outward openings to permit the ends of the wires to be turned.

An improvement in hanger for trolley wires has been invented by Augustus Neubert, of Elizabeth, N. J. The number of the patent is 768,863, the date, August 30, 1904. The object of this in-

TROLLEY HANGER.

vention is to provide an improved device provided with means for clinching trolley wires, and securing the same thereto and so securely as to prevent the possibility of the wire being released and enabled to drop therefrom. This improved hanger comprises a clencherhead and a suspending element, which is of cylindrical form, provided at its upper end with a screw-socket to enable a disconnector to be screwed to the said suspending element. At the centre of the clencherhead the same is formed with a boss or swelled portion, which in practice is united to the enlarged lower end of the suspending element by braces.

James Burke, of Berlin, Germany, has obtained letters-patent of the United States, No. 768,843, dated August 30, 1904, for an improved armature, and has assigned the same to the Burke Electric Company, a corporation of New Jersey. The invention relates to armatures, and has particular reference to the manner of securing the armature windings upon the core. The object is to construct an armature to which form-wound coils of windings may be applied practically without distortion and in which the slots may be of approximately the same sectional width



ARMATURE.

throughout their entire length without diminishing in any sensible degree the mass of iron left standing between the notches. The invention consists of an armature having slots tangential to an inner circle for the reception of armature windings, said slots all being uniformly inclined.

Robert A. Hadfield, of Sheffield, England, has obtained letters-patent of the United States, No. 767,110, dated August 9, 1904, for an improved method of making magnetic materials. The idea of the invention is to treat magnetic materials in the form of thin sheets or the like for the purpose of increasing the permeability and electrical resistance and decreasing the hysteresis. The treatment is as follows: the sheet or other thin material is first heated to a temperature considerably below its melting point, then allowed to cool, preferably quickly, by exposure to atmospheric air of ordinary temperature. The material is then reheated to a temperature higher than that employed during the first heating, but still below the melting point. It is now allowed to cool very slowly, preferably by leaving it in a furnace, the cooling being often extended several days. In a common crucible, pure iron with silicon is melted, employing a percentage of these varying from one-quarter of one per cent to eight per cent. The molten alloy is poured into suitable ingots, which are then rolled into sheets in the usual manner. The method of producing a magnetic material of high permeability and low hysteresis action, which consists in alloying a magnetic substance with silicon, reducing the alloy to a thin body, heating such thin body to a temperature below its melting point, allowing it to cool, reheating it to a temperature above that first employed, and again allowing it to cool.

Electric Power Used in Constructing the Railway Line Around Lake Baikal.

Electrically operated rock drills have been used, with much success, in cutting the railway line which passes around Lake Baïkal, in Siberia. This section of the road is a little over ten miles in length, and in construction it was necessary to cut thirteen tunnels, having a total length of over a mile and a half. There are also many open cuts through rock. For this work electric power offers advantages, and a steam generating station was constructed at the middle of the section, where a ninety-horse-power engine driving a dynamo was installed. The system used is three-phase, 2,200 volts, and the high-tension current is distributed to four substations, where it is transformed to a simple alternating current of 125 volts, for use in the drills. It is also transformed into continuous current at 175 volts for lighting and operating pumps and ventilators. Thirty drills have been used. Lighting is effected by eight arc lamps and 200 incandescent lamps. There are, further, six centrifugal pumps, which draw water directly from the lake and supply it by means of pipes to the drills. This installation has been at work for over a year.

A Subway for Washington.

A standard electric railway will be constructed in Washington, connecting the two new office buildings to be erected for the use of representatives and senators. The track will be carried in a subway, which will also have broad cement walks. In addition, a freight service will be conducted through the subway. A power plant to cost $700,000 will be a part of this plant. It will furnish power and light to the railway and elevators in the capitol and office buildings, and to the congressional library.

Reviews of Current Engineering and Scientific Literature.

The Hydraulic Power of the Pyrenees.

An abstract is here given of a recent communication by M. Marchand, in which an attempt is made to obtain a figure indicating approximately the useful water power of the French slope of the Pyrenees. The problem is beset with difficulties, and at best but a rough figure is obtainable. It is thought, however, that sufficient allowance has been made for errors, the final result being, if anything, too small. To arrive at this a process of approximate integration was adopted, and the average height of fall was estimated; then, from the yearly rainfall and by estimating the areas on which this fell, it was possible to reach a figure at least of the order of the usable power. After making due allowance for evaporation and other losses, the power of the French slope of the Pyrenees is given, in round figures, as 8,000,000 horse-power; or, in other words, power sufficient to run 26,000 locomotives, each of 300 horse-power, continuously day and night.—*Translated and abstracted from La Houille Blanche (Grenoble), May.*

A Natal Three-Phase Transmission Plant.

The first use of water power for electrical purposes in Natal is that developed by J. L. Hulett & Sons at Kearsney. The station was installed to supply light and power to the large tea works of this company. The plant is about three and one-quarter miles from the factory, situated on the Umvoti river, from which power is derived. By means of a dam, the level of the stream has been raised, and water is conducted by means of a race three-quarters of a mile in length to a point where a working head of thirty feet is obtainable. This arrangement makes available 300 horse-power in the dry season. At present a turbine rated at 136 horse-power drives, by means of a belt, a three-phase, 100-kilowatt generator giving 11.6 amperes at 5,000 volts, fifty cycles per second. The switchboard is of very simple design, all live parts being kept at the back. The overhead lines are carried on solid-drawn weldless steel tubes thirty feet high, spaced forty yards apart. The wires are supported by triple-petticoat porcelain insulators. At cross roads wire guards have been fixed below the lines. Everything about the plant has been made as simple as possible, so that it may be operated by the most inexperienced person. At the works, the voltage is lowered by transformers to seventy. It is then distributed to induction motors and to the lights. The motors are used for driving the ventilating fans and the rolling machinery. They are also used in the shops. —*Abstracted from the Electrical Review (London), August 26.*

State Telephones in England.

This article discusses the telephone situation in England, with particular reference to the conditions in London. The report of the post office shows a total deficit in telegraphs of nearly $5,000,000. To this must be added the interest on the capital created for purchasing purposes, which brings the total up to $6,400,000. Deducting from this the amount expended on telegraph extensions, it appears that the net loss on the actual working of the telephone system was over $3,000,000 for the year ending with March last. The deficit has been increasing from year to year, and it apparently will continue to grow. These figures support the arguments that have been made, that the London post office service is being run at a loss of about $20 per telephone per year. The total capital expended on the system is over $7,500,000, and as the total number of telephones is less than 16,000, the average capital cost per working telephone is $485. At the same time, the cost of construction per mile of underground wire is going up. The length of wire required for each subscriber's line is also increasing. At the present time each telephone in London should contribute about $30 a year to meet the depreciation and interest, and between $20 and $25 for working expenses. The report shows that for the year covered, the earning power of the present system was a little over $35 per telephone. The present loss is, therefore, as stated, about $20 per year. It is believed that for many years it will be impossible to reduce the average capital cost per working telephone below $300; and even at that figure, a higher average revenue than is now received would be necessary to make the system pay its way. —*Abstracted from Engineering (London), August 26.*

The May-Oatway Fire-Alarm System.

An ingenious, and what is said to be a reliable fire-alarm system is here described by M. G. Courtois. The device which gives the signals consists of a fine copper wire attached to an iron angle bar. This is placed in a horizontal position at the point to be protected, and from the centre of the copper wire a small weight is suspended. This weight is enclosed within a glass tube for protection, and below the weight is placed a pair of silver springs mounted on an ebony block. This method of suspension allows the weight, which is tipped with a carbon cone, to fall through a considerable distance for a slight change in the relative lengths of the copper wire and the iron angle. The descent of the weight closes the circuit between the two silver springs and sets off an alarm. The peculiar advantage of this type of signal is that the copper wire, being small and having a high conductivity for heat, is more readily affected by sudden changes in temperature than is the iron which supports it. A sudden rise of ten or fifteen degrees is sufficient to cause the weight to fall and to set off the signal; but if the temperature rises but slowly, due to turning on heat in a room, the iron bar follows the change in temperature, as well as the copper wire, and thus compensates for the change in length of the latter. By a proper adjustment of the length of wire and of the glass tube enclosing the weight, it is possible to adjust this apparatus for changes in temperature ranging from ten degrees below to fifty degrees above zero centigrade, while, as mentioned above, a sudden change of ten or fifteen degrees will send in an alarm. This system has been worked up in complete form by the inventors, MM. May and Oatway, the apparatus not only sounding an alarm, but signaling the point where a danger exists.—*Translated and abstracted from La Revue Electrique (Paris), July 30.*

Three-Phase Transformers.

The comparative advantages of single and polyphase transformers are here discussed by Mr. J. S. Peck. The first claim made for the polyphase transformer is a saving in material. In both the shell and core types a three-phase transformer contains less material than three single-phase transformers having the same aggregate output. The cost of transformers, on the other hand, decreases rapidly while the efficiency increases, with an in-

crease in size, so that one single-phase transformer is cheaper and better than a polyphase transformer of the same rating. The conclusion is reached, that where it is desired to transform from three-phase to three-phase, for supplying small motors, the three-phase core-type transformer is cheaper, more efficient and more compact than a group of two or three single-phase transformers. Any three-phase transformer which is made up of three single-phase units joined by a common core, presents but little gain in cost, efficiency or compactness over three separate single-phase units. For large three-phase units the shell-type construction is commonly employed. In the opinion of the author, it has few advantages and several disadvantages when compared with a group of three single-phase transformers. The advantages claimed for the three-phase shell-type transformer are: slightly reduced cost, less floor space, and simplification of connections as compared with a group of three single-phase transformers. The duplex transformer—that is, two single-phase transformers connected in T and mounted in the same case—is a cheaper arrangement than the three-phase transformer. The connections are just as simple, and it requires slightly less floor space. No three-phase transformer or group of single-phase transformers can be as cheap, efficient or compact as a single-phase transformer having the same aggregate output. Thus, the economical use of the three-phase transformer is practically limited to supplying three-phase motors and rotary converters. The single-phase transformer can almost always be used to better advantage for lighting work.—*Abstracted from the Electric Club Journal (Pittsburg), August.*

The Movement of Metallic Ions through Glow Discharges in Free Air.

It has been said by certain investigators that it is impossible to demonstrate the movement of matter in glow discharges. This contention is denied by Herrn. E. Riecke and J. Stark, who in this article describe several experiments which demonstrate the actual transportation of metallic ions by means of the glow discharge. To carry out the experiments, two copper rods four millimetres in diameter were used as electrodes. The source of potential was a storage battery giving 3,600 volts. Under suitable conditions a glow discharge was obtained between the two electrodes. Introducing into this discharge beads of lithium, sodium, potassium or calcium chlorides, the characteristic colors served to show any transportation of the metallic ions. Two arrangements of electrodes were tried, one in which they were placed horizontally, and the other, vertically. In the horizontal position, a bead introduced at the cathode imparted its characteristic color to the discharge, but this color was localized around the bead and between it and the cathode. On the other hand, when the bead was introduced at the anode, the characteristic color appeared throughout the whole path of the discharge between the two electrodes. With the vertical arrangement, two conditions were possible. The cathode might be either at the top or at the bottom. With the cathode at the top, and a bead introduced near it, the characteristic color appeared only throughout the upper part of the discharge. When the cathode was at the bottom, the entire discharge was colored. When the bead was placed near the bottom electrode, the upward rush of heated gases carried along the vapors given off by the bead, and this effect masked any coloring of the discharge due to the electrical transport of the metallic ions. These experiments seem to the authors to demonstrate clearly that a motion of matter due to the glow discharge takes place. The direction of this motion is from the anode to the cathode, and the results further seem to substantiate the supposition suggested by one of the authors, that the characteristic color is due to the positive ion.—*Translated and abstracted from Physikalische Zeitschrift (Leipsic), September 1.*

Tests of Electric Hauling on the Teltow Canal.

A review is here given of the recently conducted tests of electric haulage on the Teltow canal. These tests were conducted by Siemens & Halske, under contract with the German government. The Teltow canal is thirty-nine kilometres long, and connects Hawel and the Spree. The locomotive used runs on three axles. Two of these are on a truck which carries the motors. The operating cab is at one end of this locomotive. The tow-rope is carried from a drum, passing through a thimble on a mast about four metres high. This mast can be raised or lowered by means of a small motor, thus enabling the locomotive and boats to pass. Power is supplied to the locomotive from two overhead trolley wires. A rail return could not be used, because of the proximity to the physical laboratory at Potsdam. Power was supplied from a temporary power-house, where a thirty-six-kilowatt generator was installed, supplying current to the line at 550 volts. The locomotive weighed about six tons, the weight on the truck being about eighty-five per cent of the total. That rail on the land side of the track carried about eighty-five per cent of the total weight of the locomotive, an arrangement adopted to give the locomotive stability when hauling with the mast erect. The motors were controlled by the series parallel system. When running alone, without hauling boats, the locomotive required four and one-half amperes at a speed of five kilometres per hour, and eight and one-half amperes at a speed of nine and one-half kilometres per hour, the motors being coupled in parallel. A train of boats hauled by this locomotive, by means of a rope eighty metres in length, was moved at a speed of four kilometres an hour by a tractive effort of eighty-five kilogrammes per ton of useful weight. The energy required per ton-kilometre was three and one-half watt-hours. Hauling the same boats at four and one-half kilometres an hour required a tractive effort of 1.035 kilogrammes per ton, requiring 4.25 watt-hours per ton-kilometre. At a speed of five kilometres per hour, the tractive effort was 1.34 kilogrammes per ton, and the energy absorbed 5.25 watt-hours per ton-kilometre. The results show that the best speed at which to haul the boats is between four and five kilometres per hour, the efficiency of the locomotive being a maximum when the speed was four and one-quarter kilometres an hour. Tests were made to determine whether boats towed in this way could pass each other without it being necessary to reduce the speed. No trouble whatever was experienced in doing this, and it was noticed during the passage of the two boats that the tractive effort required fell about ten per cent. During part of the test the locomotive ascended a grade of one in twenty while towing a boat. The principal difficulties experienced in these tests were in towing around curves, as those on the canal are rather sharp, and it was difficult to handle the tow-rope. Estimates were made to determine at what point electric towage would be cheaper than towing by steam. For this canal, this point is reached when the annual traffic is about 2,000,000 tons. Above this point, electric traction is cheaper; below this point, steam has the advantage.—*Translated and abstracted from La Revue Technique (Paris), August 25.*

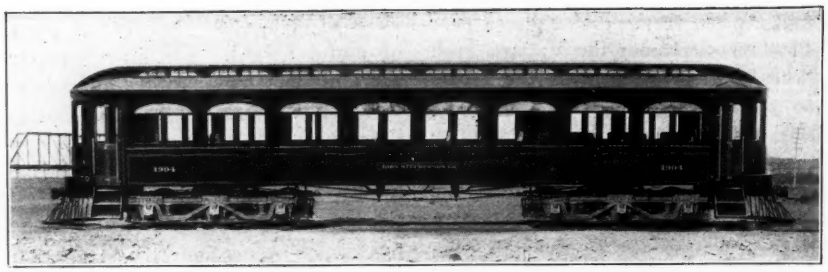
INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The John Stephenson Company's Exposition Car No. 1904.

In constructing this car the John Stephenson Company has made no attempt at fancy work or elaborate finish, using nothing but standard woods and plain bronze trimmings. The idea in designing it was to build a car which would be suggestive to those interested in interurban electric railways of exceptionally high speed.

The general dimensions are as follows: length over corner posts, forty-six feet; length over bumpers, fifty-seven feet; total length, sixty-one feet six inches; width over sheathing, eight feet nine inches; height from bottom of sill to top of roof, nine feet eight inches.



THE JOHN STEPHENSON COMPANY'S EXPOSITION CAR NO. 1904.

It is framed very rigidly and is exceptionally well braced and trussed to withstand the heavy and severe strains experienced in a high-speed service.

The floor framing consists of six sills, the four centre ones being six-inch "I" beams with wood fillers, extending the entire length of car. The side sills are double and are made of yellow pine with steel plate sandwiched between them. The cross bars are of malleable iron, and each carries two tie rods and is so arranged that electric or air brake apparatus may be easily suspended therefrom. On top of these bars is laid one-quarter-inch Transite board. The floor is placed on top of this and securely fastened to side and centre sill fillers. All the wood fillers are covered with Transite board, the whole reducing the entire underside of car to a minimum possibility of burning, and at the same time producing a frame that will not give out that disagreeable resonant sound so common to those constructed entirely of metal. In addition, the bottom frame is equipped with built-in double bolsters, having steel centres, all parts being machine-fitted.

The king pin is three inches in diameter and the centre plate exceptionally heavy. Special care has been taken in construction of these bolsters to make them perfectly rigid so as to withstand the heavy and severe strains before mentioned. The total weight of this bottom frame is 20,000 lbs.

The platforms, or vestibules, of the car are constructed to accommodate one or two operators, and are not made for the purpose of carrying passengers. These vestibules taper toward the ends of the car so as to present the least possible resistance of the air. Although somewhat small, there is enough room in the centre of the vestibule for the motorman to operate and at the same time allow free passage for passengers to and from the car.

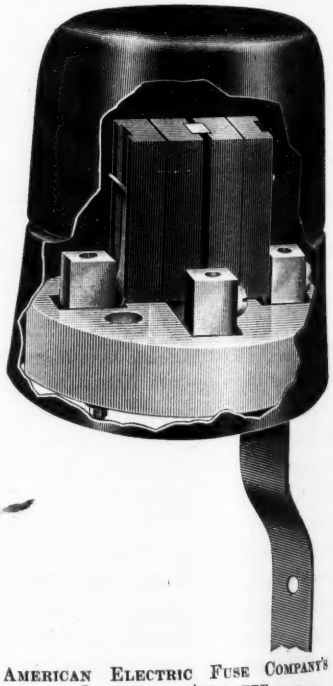
The body itself is divided into three compartments — smoker, passenger and private. The smoking compartment is finished in cherry and has leather upholstered vis-a-vis seats. The passenger compartment is finished in quartered oak and has regular rattan upholstered walk-over seats. The private compartment is finished in mahogany and is equipped with six plush-covered revolving chairs. The total seating capacity of these three compartments is fifty-two.

Six-wheel trucks, absolutely necessary for very high-speed service, have been designed and built for this car. With a six-wheel truck, defects in the roadbed will be covered up which might be shown by a four-wheel truck.

These trucks are built heavier than the ordinary six-wheel railway type on account of the motors they will carry. The side frames are made of "I" beams with solid steel fillers, all of these fillers being milled and machine-fitted. The wheels are thirty-six inches in diameter, steel-tired, with M. C. B. standard treads and flanges. On the centre wheel the flange has been omitted in order to enable the trucks to take sixty-foot curves. The axles are six and a half inches in diameter, with journals five and a half by nine inches. The oil boxes are malleable iron, and all other castings on these trucks are either malleable or steel, the only gray iron being the brake shoes. The wheel-base of driving axles is ten feet four inches. The truck bolster is of special construction and built exceptionally rigid to withstand the heavy work required of it. In designing this truck many new features had to be introduced in order to accommodate the motors and at the same time maintain the riding qualities peculiar to the six-wheel truck. The weight of the trucks is 19,000 lbs. The complete weight of body and trucks is thirty-nine tons.

A Lightning Arrester for Telephone Work.

A useful lightning arrester, suitable for outdoor work, and one which can be placed on the side of a house or on a pole where the subscriber's line drops off, is shown in the accompanying illustration.



AMERICAN ELECTRIC FUSE COMPANY'S LIGHTNING ARRESTER.

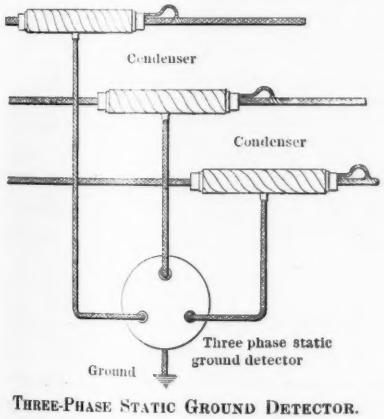
This arrester can be used all along a pole line placed at intervals of half a mile, or at the points of transposition. It consists of a porcelain base supporting large carbon surfaces, one thousandth of an inch apart. These are arranged so that

the arrester is self-cleaning, any dust due to a discharge falling out at the bottom. The wires enter at the bottom through the three binding-posts, two for the line and one for the ground. They are fastened by screws, and when the wires are connected up the carbons are looped in on the line. The parts of the arrester are attached firmly to the porcelain block, and the whole is covered by a neat galvanized dome and supported on a galvanized iron bracket. It is said that it is quite unaffected by the weather, meets the underwriters' approval, is easy to place and will last indefinitely. It can be used on any kind of telephone line.

This arrester is manufactured by the American Electric Fuse Company, 48 West Jackson Boulevard, Chicago, Ill., and is designated as No. 402 Protector.

A New Three-Phase Static Ground-Detector.

Static ground-detectors, designed to enable the central station operator to determine at a glance whether a ground exists on a single-phase circuit, have become well recognized as a necessary part of every first-class installation. These single-



THREE-PHASE STATIC GROUND DETECTOR.

phase instruments are entirely satisfactory on two-phase circuits as well. For three-phase circuits, however, although the practice has been to use two or three single-phase instruments either in separate cases or combined in the same case, this arrangement is open to the objection that the indications of the pointer are not direct, some time being required for a person not familiar with the instruments to determine which line is grounded. It is only recently that a design has been produced which enables a ground in a three-phase circuit to be indicated directly by the use of one instrument. The accompanying illustration shows the three-phase static ground-detector made by the Westinghouse Electric and Manufacturing Company and supplied for circuits of from one thousand to fifty thousand volts potential.

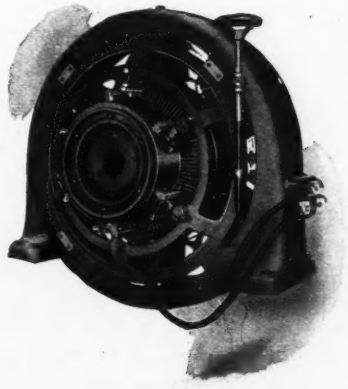
Its method of operation is indicated by the diagram of connections. It will be seen that each of the three fixed vanes is connected to a line of the three-phase circuit. The central movable vane is electrically connected to the case, which is grounded. When there is no ground upon the circuit the attraction or pull upon the central vane from each of three fixed vanes is balanced, and it does not deflect from a central position. Should one of the lines become grounded, and the potential of that line become the same as that of the movable vane, there will be no pull in that direction, and the movable vane will be deflected away from the grounded line. The instrument is reliable in its indications, and has no complications in its mechanism or construction.

In the diagram, the three leads to the ground-detector are shown with a condenser inserted between each line and the instrument. This obviates the necessity of carrying high-tension wires to the front of the switchboard. Each of the condensers consists of a brass tube covered with insulating material, and placed within a copper sheath, the line being connected to the inner tube and the lead to the copper sheath.

This ground-detector is ornamental in appearance. In shape and size it corresponds with the other Westinghouse round pattern switchboard instruments. The interior of the case is given a dull black finish against which the aluminum vanes stand in distinct relief, while the angles of deflection marked upon the glass face form a pleasing geometrical design. In every way it is a high-grade instrument.

Engine-Type Generators.

The Sprague Electric Company, New York city, which for many years has been remarkably successful in the design and



ENGINE-TYPE GENERATOR.

construction of high-grade electrical apparatus, is calling special attention to its M. L. engine-type generator. This apparatus has been in actual service for a number of years, and has proven its quality in difficult situations.

The accompanying illustration shows this machine, which was designed to meet the requirements of modern practice. Its operation, the manufacturer states, satisfactorily demonstrates the claims made for high efficiency, low temperature, sparkless commutation, compactness, strength and endurance. The highest class of workmanship and material is used in the construction of this machine, ensuring the best possible commercial results.

The Alcock Electric Ship's Telegraph.

The Alcock ship's telegraph, manufactured by Brooker & Goss, Limited, London, England, appears to be an accurate and safe device for signaling between the bridge and engine room of steamers. It offers little opportunity for mistakes, as the action of the engineer in response to signals is registered immediately on the bridge by means of an attachment to the propeller shafting. Corresponding instruments are placed on the bridge and in the engine room. By moving the handle of the former the needle on the engine-room instrument is immediately set with the corresponding order and at the same time a bell is rung continuously until the lever of the engine-room instrument is moved to correspond with its needle. This, then, sets the needle on the bridge instrument to correspond, indicating that the order has been correctly received. The bell on the bridge instrument is set ringing at the same time that the order is signaled to the engine room and stops only when the reply signal comes from the engine room. The office of the bell is merely to enforce prompt obedience; the needle on the dial showing whether the order has been correctly carried out. The engine-room instrument is usually fixed on the engine stanchion in proximity with the starting gear, so that it is very convenient for the engineer to work. Battery power is furnished by a nine-cell accumulator, twenty to thirty ampere-hour capacity, having a discharge rate of two to three amperes. The battery should go eighteen volts approximately when newly charged and should be recharged when it drops to sixteen. The instrument, however, will work as low as ten volts.

Machinery Day (St. Louis, Mo.) Souvenir.

The exhibitors in the department of machinery, Louisiana Purchase Exposition, St. Louis, Mo., have published a handsome souvenir invitation to the reception in the Palace of Machinery and Imperial Japanese Gardens, on the evening of Machinery Day, September 10. This souvenir, which consists of six pages of splendidly printed and embossed literature and half-tones, is bound in a handsome cover embellished with a design symbolic of the primitive use of steam.

Stage Lighting Apparatus.

The necessities of the modern stage require a variety of illuminating apparatus; to meet these extraordinary requirements, the ingenuity of the electrician finds a wide scope. The Universal Electric Stage Lighting Company, New York city, manufactures apparatus to supply every theatrical demand. Its apparatus is found in the principal New York theatres, as well as in other large cities of the United States. The apparatus here shown, as well as the rest of the product of the company, meets the latest requirements of the underwriters. All of the lamps have specially enclosed rheostat and switch with asbestos cable from the rheostat to hood with all terminals enclosed.

Fig. 1.—Universal Open-Box Arc Lamp.

Fig. 2.—Sciopticon for Snow, Rain and Cloud Effects.

Fig. 1 shows the Universal open-box arc lamp which is spark-proof, well ventilated and provided with grooves for cover slides, screen door and Chicago hood.

The company has recently perfected an enclosed lens box, constructed with aluminum front and rear, Russian iron hood with double doors and well ventilated. The size of the focus may be varied by the mere turning of a handle in the rear.

Fig. 2 shows the "sciopticon" used for producing various novel effects, such as snow, rain, clouds and fire. This instrument is used behind a transparent drop or in the wings. It can also be used from the front of the house. It is readily portable and adapted for road work.

Fig. 3 shows an electric bunch light with a round head. This is arranged for seven or ten lamps. It can also be furnished with a square head adaptable for any number of lamps.

Fig. 3.—Electric Bunch Light.

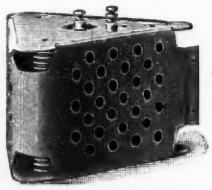


Fig. 4.—Universal Fixed Rheostat.

The Universal fixed rheostat illustrated in Fig. 4 shows the coil complete. It is wound for low-tension current, fifty-two and 110 volts, alternating, and 110 volts direct. It is triangular in shape and well ventilated. The resistance wire, giving a specific resistance three or four times greater than that of German silver, is wound around a triangular frame of porcelain tubes. Three terminal posts are provided, one for each end of the wire and a third for a tap half way between the terminals. The company also manufactures electric display signs.

A New Moulding Receptacle.

The H. T. Paiste Company, Philadelphia, Pa., has made an important addition to its line of "P.-K" show-window fielding receptacles. The new receptacle is designed as catalogue No. 34,353, and is adapted for use with horizontal moulding. The receptacle, catalogue No. 33,582, which is a sixty degree angle receptacle, and is for use with vertical moulding, was described in the Electrical Review for August 6, 1904.

All of these show-window receptacles are provided with "ratchet-locked" porcelain rings which can not come loose until the receptacle itself is unscrewed from the moulding.

The new receptacle, No. 34,353, has met with instant recognition, and with these two styles, a line of lights can be run around a window, with all the lamps and shades held at a common angle, and all the light thrown upon the window display.

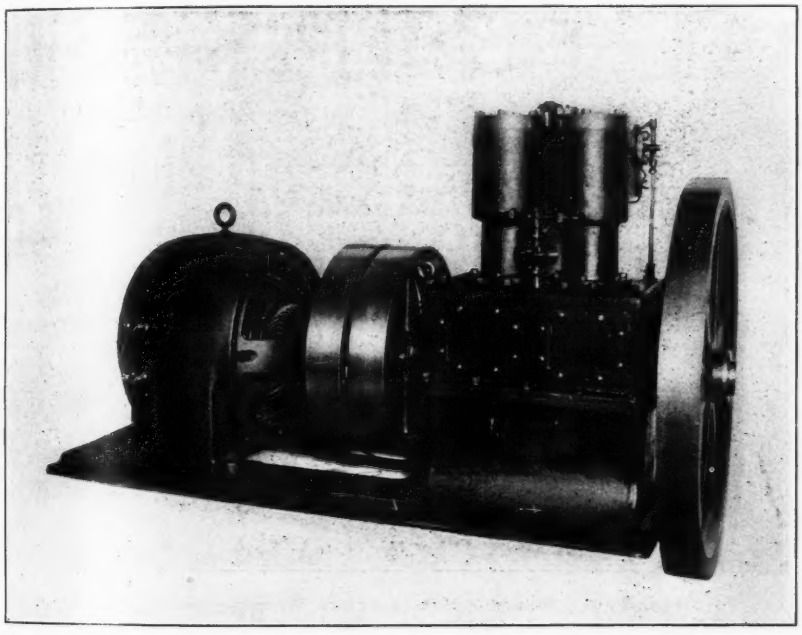
Pumping Machinery at St. Louis.

Forty types of pumping machinery at the St. Louis Exposition are described and illustrated in a handsome pamphlet now being distributed by the International Steam Pump Company, 114 Liberty street, New York city. Under this heading are included not only the many types of pumps exhibited, but also air-compressing and steam-condensing apparatus, cooling towers, vacuum machines, water meters, and so forth. The processes in which these machines are employed on the Exposition grounds, such as timber-preserving and refrigeration, are fully explained, and diagrams and graphical charts are employed to illustrate the design and arrangement of apparatus. A view of the Grand Cascade is shown on the cover, and the immense Worthington turbine pumps by which water is supplied are described in the text. The publication is distributed free.

Gas Engines for Private Lighting Plants.

The economy in fuel and the simplicity of operation, make gas engines very desirable for private lighting plants. The engine here illustrated was designed especially for direct-connection to the dynamo for private purposes and meets the requirements in every respect. On a varying load it will regulate within two per cent and on a steady load within less than one-half of one per cent. The space occupied by the engine and dynamo is forty by seventy-eight inches. Natural or manufactured gas or gasoline can be used as fuel. The engine is built by the National Engineering Company, Bradford, Pa.

The dynamo, a forty-five ampere multi-



TEN-HORSE-POWER GAS ENGINE, AND FORTY-FIVE-AMPERE, MULTIPOLAR, SLOW-SPEED, OPEN-TYPE GENERATOR.

polar slow-speed machine, is built by the Ideal Electric and Manufacturing Company, Mansfield, Ohio. A brief description follows: the magnetic frame of cast-iron of the highest permeability is cast round to insure the shortest magnetic circuit possible. The magnetic poles are slightly offset in the frame, allowing the commutator to set back somewhat and giving it protection against damage from external sources. The armatures are of the iron-clad laminated type of construction. The coils and slots are independently insulated. The cores are made of thin discs of special double annealed electrical quality steeled sheets. The commutators are of a specially rigid construction; the segments are made of rolled or drawn copper bars of the highest conductivity. The shells and flanges are so constructed that when the commutator has been assembled there is no possible way for the parts to become loose and work up or down.

Steam Turbine Condensing Outfits.

At the present time much interest centres in the steam turbine, which promises to reduce the weight and cost of prime movers. Two large machines of this type are on exhibition in block fifty-one, aisle one, and block forty-four, aisle ten, Machinery Building, at the St. Louis Fair, one being shown by the Westinghouse Machine Company and the other by the General Electric Company. Economic utilization of the energy of steam requires its expansion to the lowest possible pressure, which in the turbine is accomplished without the usual losses due to the correspondingly extremely low temperatures. In actual service the economy of the turbine is increased by approximately three to five per cent for each inch of vacuum higher than twenty-six. It is, therefore, of vital importance that all losses should be reduced to a minimum. The absence of oil from the steam renders the use of a surface condenser desirable in places where the saving of condensed steam is important. The fact that the final temperature of the condensing water must be comparatively low necessitates the highest degree of efficiency in its use and the immediate and complete removal of all non-condensable vapors, whose presence would increase the absolute pressure and consequently reduce the efficiency of the turbine.

The steam from the Westinghouse-Parsons turbines at block fifty-one is condensed in a 1,500 square foot surface condenser, supplied by Henry R. Worthington. The air is removed by a Worthington rotative dry vacuum pump of the centre-crank type, but similar in other respects to the horizontal pumps already described. An air-cooler is interposed between the condenser and the vacuum pump, considerably increasing the capacity and efficiency of the latter. The condensed steam is removed from the condenser by a Worthington volute pump directly connected to an induction motor. The operation of this pump is very interesting, since it requires neither valves nor floats and is not subject to vapor binding, as are reciprocating pumps. The pump is placed below the level of the condenser, receiving the water by gravity, and its capacity is such that it runs ahead of the supply, so that the suction pipe is never full. The discharge pipe is, however, always full and presses back against the pump, but so long as the latter is in motion there is no possibility of the water passing back to the condenser, so no automatic devices are needed. In another turbine plant a pump of this character returns the hot water directly from the surface condenser to the boiler against a pressure of 250 pounds.

The Curtis steam turbine, exhibited by the General Electric Company in block forty-four, is of the vertical type, and the condenser is placed in the base of the steam turbine. It contains 8,000 square feet of tube surface, and was built by Henry R. Worthington. The air is removed by a rotative dry vacuum pump, similar, as regards the air end, to those heretofore described, but driven through the medium of a silent chain by an electric motor.

New Plan for Removing Ice and Sleet from Third Rails.

The removal of ice and sleet from conductor rails by mechanical means has been found impracticable. Mr. William Greenow, Jr., has devised a method which is apparently superior. His plan is to heat the rails above the temperature of the surrounding air by means of an electric current. The heating wire extends along the length of the third rail, insulated from it by porcelain brushings and held in position by wooden strips which also serve to enclose it. Tests made in the yards of the Connecticut Railway and Lighting Company at Bridgeport, Ct., have proved quite satisfactory.

INTERNAL COMBUSTION ENGINES FOR ELECTRIC LIGHT AND POWER.

EXHIBITED BY THE WESTINGHOUSE MACHINE COMPANY AT THE LOUISIANA PURCHASE EXPOSITION.

The Westinghouse gas engines operating in the joint Westinghouse exhibit in Machinery Hall are of great interest. Engines of moderate size have been selected as offering greater facility for inspection by visitors than larger units. Two types of gas engines are on exhibit: the vertical single-acting and the horizontal double-acting. Both are multi-cylinder machines, the former having three cylinders with cranks at 120 degrees angularity, and the latter two cylinders arranged in tandem with single crank. Both engines are connected to engine-type generators and are continually maintained in operating condition, generating, when required, part of the current necessary for operating the exhibits of the various Westinghouse companies in the palaces of Machinery, Electricity and Transportation. The engines are piped to the city illuminating gas supply, and although they will be operated for short periods under all conditions of load for purposes of demonstration, it is not contemplated to make long continuous runs on account of the high cost of the illuminating gas which is available on the exposition grounds.

As the double-acting engine is of somewhat more recent introduction than the longer established single-acting type, a brief description of its most important features may be of interest. General data regarding the unit are given below:

Diameter of cylinder, fourteen and one-half inches; diameter of shaft, nine and three-quarter inches, maximum; diameter of shaft at bearings, seven and one-half inches; length of stroke, twenty-two inches; number of revolutions per minute, 200; length of unit overall, twenty-seven feet four and one-half inches, including flywheel; width overall, seven-foot engine, 13.3-foot unit; height overall, eight feet two inches, including flywheel; flywheel diameter, eight feet nine inches; rated capacity, 200 brake-horse-power; ratio of crank to connecting rod, 1 to 5.45.

Generator—engine type:

Number of poles, eight; voltage, 125 to 250, three-wire balanced system; rated capacity, 100 kilowatts.

The engine consists essentially of two water-jacketed, double-acting cylinders arranged in tandem with distance pieces providing space for access to the packing boxes between cylinders. Distance pieces are also used between the forward cylinder and crosshead guide for a similar purpose.

The forward part of the engine—the frame—comprises the housing for the crosshead guide, two main bearings and a bed-plate; the two cylinders and all the valve mechanism are supported by a bed-plate extension bolted to the bed of the engine frame, both of which are grouted with concrete to the foundation. Cast-iron exhaust pipes convey the burnt gases through the floor to a six-inch exhaust main leading to the atmosphere. Cooling water inlet and return pipes and gas and air supply pipes rise through the floor, thus removing complex and unsightly piping as far as possible from the engine-room floor. A flywheel of moderate weight is provided, with an outboard bearing pedestal, the generator in this case being of the engine type and mounted upon a separate concrete pier rising from the common foundation. The accompanying print shows in outline the general arrangement of the unit and the relation of its most principal parts. The numerous details are, however, shown to better advantage in the photographs.

A noticeable feature of the general design of the engine is its resemblance to a modern high-speed tandem-compound steam engine, and, in fact, the experience of its builders in steam engine work has been largely brought into service in the design of the gas engine. This resemblance is particularly noticeable in the case of the main engine frame, shaft and cranks, flywheels, bearings, connecting rods and arrangement of generator with outboard bearing. A more generous proportioning of parts has, of course, been necessary to accommodate the increased pressures resulting from the rapid combustion of highly compressed gases.

The Beau de Rochas or four-stroke cycle is exclusively employed in this as well as the single-acting type of engine.

An important source of economy lies in the method of controlling the combustible mixture. As the quality of gas does not ordinarily vary widely, a most efficient proportion, once obtained, enables the engine to operate thereafter with maximum economy, since the governing is then effectively accomplished by varying the quantity of mixture admitted to the engine according to the load to be carried. As the mixture is always of constant quality and as positive scavenging prevents it from becoming vitiated upon its admission to the cylinder, the maximum duty per unit of gas used is secured.

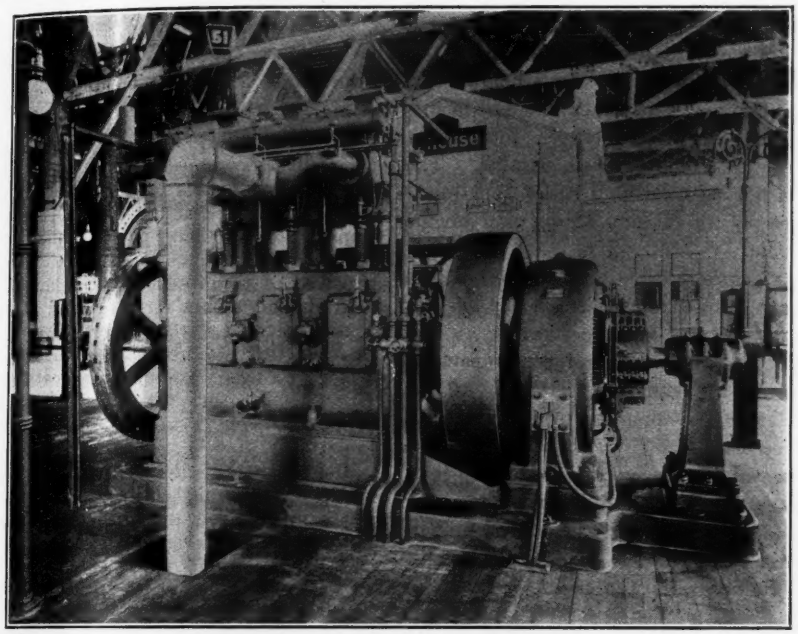
125-HORSE-POWER, VERTICAL, SINGLE-ACTING, WESTINGHOUSE GAS ENGINE, MACHINERY HALL, ST. LOUIS, MO.

The detailed construction of the engine embodies in modified form the essential features which have contributed to the success of the Westinghouse vertical single-acting gas engine. In some respects it presents a departure from the accepted European gas engine practice.

The shaft is constructed of open-hearth forged steel built up with two cylindrical crank discs thirty inches in diameter, presenting a smooth exterior face but cored out in the rear with suitable pockets for counterbalancing with lead.

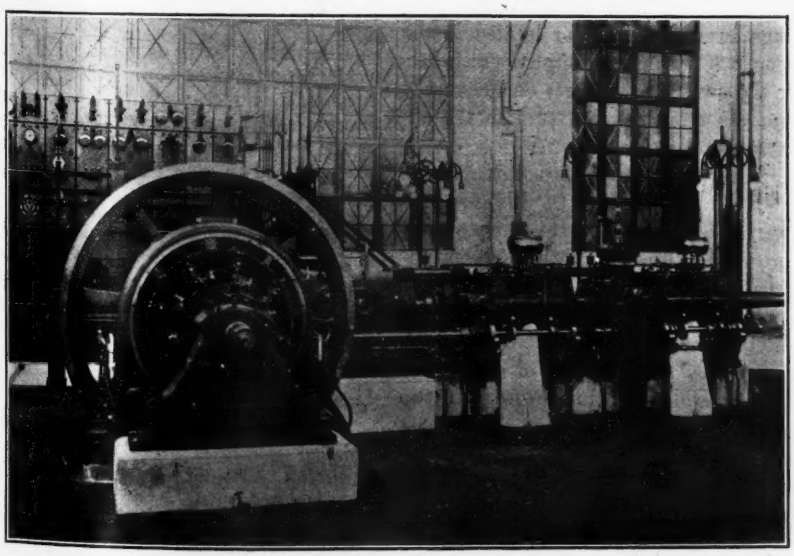
Proper speed of rotation is communi-

cated to the cam shaft by a spiral gear split in two halves and secured to the shaft close to the engine frame by key and bolts. The lay or cam shaft which extends along the entire length of the engine and



125-Horse-Power, Vertical, Single-Acting, Westinghouse Gas Engine, Direct-Connected to Standard Two-Wire, Direct-Current, Westinghouse Generator, Machinery Hall, St. Louis, Mo.

at ninety degrees to the main shaft is thus positively driven at one-half the speed of the engine, this relation being necessary to obtain the proper valve movement in a four-cycle engine.



250-Horse-Power, Westinghouse Horizontal Gas Engine, Connected to Three-Wire, Double-Voltage, Direct-Current Generator, Machinery Hall, St. Louis, Mo.

In the main bearings, a four-part or quarter-box arrangement is used, the bearing being adjustable horizontally by wedges set up by bolts extending through the caps. The upper quarter of the bearing and the cap is cast integral, the latter being provided with lips which overhang the vertical sides of the bearing, thus contributing greatly to its rigidity. In the outboard pedestal a two-part bearing is used, the lower shell of which is adjusted vertically by a wedge. As the pedestal itself rests upon a sole plate, horizontal adjustment is secured by wedges engaging its foot of the pedestal.

The crosshead and connecting rod are typical of modern steam engine construction. The former has removable babbitted shoes overlapping the ends of the crosshead and adjustable by wedges. These shoes are bored and turned about a common centre, so that by slacking off the wedges the shoe may be slid out of position without disturbing the adjustment of the remaining parts.

Both ends of the connecting rod have split bronze boxes and are adjustable by means of wedges, the crosshead end being of the solid, and the crank end of the strap type.

A striking feature of the cylinder construction is that the cylinder, combustion chamber, ignition and exhaust ports, together with the water-jackets for the respective parts, are made in one casting. In order to reduce the strains in the metal of the jackets while cooling, the jacket wall is split around the periphery, the opening being closed by a steel tension band and a strip of rubber packing. Suitable hand holes are provided at various points in the water-jackets for examining the interior, and to remove sediment which might be precipitated in case very dirty water were used in the jackets. The cylinder heads are of ample length to accommodate the packing gland and to provide for adequate water-cooling passages. The heads are slightly tapered where they enter the cylinder bore, and starting screws are provided around the flanges so as to facilitate the removal of the heads.

The combustion chamber is approximately circular in horizontal section and is closed by the admission valve above and the exhaust below. Both valves are of the single-beat, poppet or mushroom type, and seat vertically along the same axis but in opposite directions, the admission valve opening downward and the exhaust upward. In the case of the admission valve, a separate bonnet is employed which, together with the valve, may be readily removed without dismantling any parts of the engine other than the tappet lever, through which cam motion is imparted to the valve. Both admission and exhaust valves are of steel and are held to their seats by spiral springs. The exhaust valve alone is water-cooled. It is bored hollow throughout its length. This bore conveys cooling water to the head of the valve, this water returning in the opposite direction through an inner concentric tube, finally emerging at the lower end. Flexible rubber tubes convey the water to and from the opening provided. It is finally turned into the jackets. By spraying a small part of the jacket water into the exhaust pipes, the temperature of the pipe may be kept at a comfortable point through the absorption of the latent heat of evaporation of the water used.

Both pistons and the piston rod are

water-cooled as well as other parts subjected to internal heat. The piston rod is of high-grade steel, ground to a diameter of four and one-half inches throughout its length. An effective means of introducing the cooling water is secured by a telescopic pipe connection bolted to the inside of the crosshead guide. The inner tube of this telescoping joint is attached to the crosshead at such a point as to convey the cooling water to the end of the piston rod bore, whence it proceeds in succession through the two pistons, emerging through a bronze tail rod extending through the rear cylinder head. Each piston is a one-piece casting, cored hollow to accommodate the circulating water, and packed by numerous cast-iron packing rings set out with flat steel springs. In order to convey the water in and out of the piston, deflecting plugs are inserted at the proper point in the rod bore. A cast-iron jacket surrounds the tail rod and receives the water emerging from it, whence it is drained away.

The difficulties arising in providing a suitable packing gland for the cylinder heads have been overcome by means of a simple metallic packing, similar in some respects to that used on high-pressure steam engines. It is compact, may be easily removed without dismantling the engine, and is capable of being made as tight as desirable without introducing friction to a noticeable degree.

The one lay shaft paralleling the cylinders operates, through cams, all of the valve movements of the engine. Independent cams are provided for inlet valves, exhaust valves and igniters, so that the action of each valve may be timed in order to secure the maximum efficiency of the cycle. The main cams are all of cast iron with working surfaces chilled and ground. Each has a throw of one inch which is communicated to the valve spindle by levers fitted at one end with hardened steel rollers engaging the cams, and at the other with adjustable steel tappet pins engaging the ends of the valve stems. All igniters, which are of the standard Westinghouse make-and-break type as employed in the single-acting type engine, are operated by a quick drop cam which is mounted in such a manner as to enable the ignition point to be varied any number of degrees in advance or following dead centre as may be most suited to the gas used.

Close and sensitive regulation is secured through a spring-weighted fly-ball governor mounted upon a vertical shaft geared to the lay shaft. This governor is in many respects similar to that employed in the Westinghouse-Parsons steam turbine and consists of bell-crank ball-levers swung on knife edges and encased in neat and substantial iron housings. By means of a special spring external to the governor the speed of the engine may be changed within small limits, this expedient being found quite necessary in synchronizing alternating-current generators and in distributing the load between them after having been thrown in parallel. The governor mechanism is easily kept lubricated by an oil cup at the top of the spindle.

As before referred to, the governor controls the speed of the engine by varying the quantity of mixture admitted at each induction stroke. The proper proportioning of air and gas, as well as the controlling of quantity to suit the load, is accomplished by means of a two-part valve. Each part is rotatable by means of an external lever moving over a graduated arc, and the proper proportioning of air and gas may be readily ascertained while the engine is in operation. Independently of this operation, however, the vertical movement of the governor valve as it receives its motion directly from the governor determines the quantity of mixture passing into the gas boxes which extend in either direction from the mixing chamber to the four-cylinder admission ports. Gas and air are admitted to the mixing valve at atmospheric pressure, secured, in the case of the gas inlet, by an automatic diaphragm pressure regulator located in the basement. With proper adjustment, whatever the pressure of the gas on the supply main, gas is always delivered to the engine at atmospheric pressure.

Starting is accomplished through the use of compressed air. In this case, the rear cylinder is used for this purpose and is provided at each end with small spring-backed poppet valves opening only with the air pressure. This cylinder is for the time being converted into a simple compressed-air motor by throwing out of service the main admission cams and throwing in two auxiliary cams which engage the exhaust valves in a double-throw instead of a single-throw movement. Two additional double-throw cams permanently mounted at right angles upon the lay shaft serve to admit compressed air at the proper moment to the starting cylinder. These operations, though apparently complex, are extremely simple in practice and involve only the temporary alteration of the cam movement by means of convenient levers, and the admission of the compressed air which is controlled by a single-plug valve. One attendant standing at the rear cylinder can readily start the engine without changing his position. After one or two strokes by compressed air, the regular combustion cycle in the forward cylinder commences and the supply of compressed air may then be cut off, the cam mechanism returned to its normal position, and the rear cylinder then comes into regular service. The entire operation of starting may be readily accomplished within one minute, and the fact is on record that with the vertical single-acting type of engine a number of 300-horse-power units have been started cold, run to full speed within a period of twenty-five seconds, and full load applied within forty seconds. Compressed air for starting is supplied by a double-acting compressor in the basement, driven by a five-horse-power motor through Morse chain gear. The air is stored at about 150 pounds pressure in three steel tanks.

Lubrication of the cylinders is automatically accomplished by two reciprocating sight-feed oil pumps operated from two of the cam levers. These pumps receive their supply from reservoirs mounted just above them, fitted with glass windows at either end so that the attendant may readily observe the height of the oil and prevent damage to cylinders and pistons from discontinuance of the oil supply. Other parts of the engine are lubricated with the usual oil cups with the exception of the crank pin, for which a special device is provided consisting of a circular groove turned in the outer face of each disc. Oil is conducted to this groove by a small pipe, and the centrifugal action forces it outward through ducts leading to the wearing surfaces of the pin.

Circulating water is piped to the several parts from cast-iron water boxes or headers located beneath the floor. These receive their supply from the exposition water system, and all parts of the engine are supplied in multiple from these headers.

The principal difference in construction of the vertical engine, outside of the different arrangement of cylinders, results from the employment of the single-acting principle, in which only the upper side of the piston receives the pressure of the expanding gases. A long trunk piston is, therefore, made use of, thus dispensing with the crosshead.

The distinguishing characteristic of the vertical engine is its self-contained construction, all the main moving parts being enclosed in a cast-iron casing which is filled with oil up to the shaft. The cranks during their revolution dip into this oil and furnish splash lubrication to all the internal parts, including connecting rods and pins and cam shaft which is also mounted inside the crank case. The construction of the engine in other particulars and its operation resemble closely that of the horizontal engine and needs no further description.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW SOUTH AMERICAN ELECTRIC TRAMWAY—The Buenos Aires Grand National Tramways Company, operating about fifty miles of horse tramways in and around the capital of the Argentine Republic, is to convert its system into electric traction. A contract has been let for 100 double-car equipments and auxiliaries.

DELAWARE & HUDSON TO USE ELECTRICITY—It is reported that the Delaware & Hudson Railroad Company has almost completed preparations to operate electric trolleys on all of its northern divisions. Plans have been made to operate the trolley cars over the rails of the steam roads, so as not to interfere with the steam traffic.

APPROPRIATION FOR WIRELESS TELEGRAPHY—The bureau of equipment of the navy department will recommend that an appropriation of about $300,000 be made for wireless telegraph installations and apparatus for the fiscal year of 1906. With this sum it is calculated that the more important stations and vessels of the navy can be equipped. The estimate will go first to Secretary Morton for approval, and he has not yet examined into the matter sufficiently to decide whether it is wise to ask Congress for such a large sum.

ALASKAN TELEGRAPH BUSINESS—The Postal Telegraph-Cable Company announces that it is now ready to accept business for Sitka, Juneau, Haines, Mission and Skagway, Alaska, by the new government cable just opened between Seattle and Sitka. The following are the rates from Portland: to Sitka, $1.75 for ten words, seventeen cents for each extra word; to Juneau, $2 for ten words, nineteen and one-half cents for each extra word; to Haines, Mission and Skagway, $2.25 for ten words, and twenty-two cents for each additional word. Reductions in rates to other places in Alaska will be made in the near future.

NEW YORK CENTRAL CLOSES DEAL FOR PURCHASE OF POWER—It has been stated that the New York Central & Hudson River Railroad Company has closed a contract with the Ontario Power Company, of Niagara Falls, Ont., by which the Central will secure the entire production of electricity for the first twenty-five years. The Ontario Power Company's plant is now in process of construction, and it is expected that it will be finished next year for the development of 8,000 horse-power. The capacity will be increased to 25,000 horse-power. At present there has been no official verification of this statement.

THE ELECTRIFICATION OF MINING PROPERTIES IN COLORADO—The first of the largest companies in Leadville (Col.) to introduce electricity in its property is the Yak Tunnel, and the work of installing the plant is progressing rapidly. The work of wiring the tunnel and making different connections with trolley wires and feeders is almost complete, and it is expected that by the middle of September the whole of the three miles of underground workings will be ready for electrical operation. In addition to the industrial railroad and the lighting of the property, electrical hoists and pumps will be installed.

CONSOLIDATION OF LONG-DISTANCE TELEPHONE LINES—Articles of incorporation have been filed at Pierre, S. D., for the Dakota Central Telephone Company, with a capital of $5,000,000. This is practically a consolidation of the long-distance lines in South Dakota under one management, and includes lines which reach into Minnesota, Iowa, Nebraska and North Dakota. Arrangements have been concluded for acquiring most of these lines, the principal stockholders being stockholders in the new company. When completed, the Dakota Central will be one of the strongest independent companies operating in the Northwest. The directors are J. L. Zeitlow, J. F. Zeitlow, W. E. Bickelhaupt, Isaac Lincoon and C. N. Herrid.

MORE LONG-DISTANCE TROLLEY LINES IN OHIO—The latest step taken by the Appleyard system of interurban lines in Ohio, in accordance with its policy of establishing, in the near future, a trans-state electric traffic, is its determination to issue forty-year bonds at five per cent, to the extent of $750,000, with which to defray the expenses incurred in the construction of an electric line between Bellefontaine and Lima, and to transform the motive power of the Ohio River & Western Railroad from steam to electricity. Upon the completion of this work in the coming spring, and by reason of the friendly relations existing between the Appleyard and the Tucker-Anthony syndicates, through interurban traffic between Wheeling, W. Va., and Lima, Ohio, will be practically completed.

ILLINOIS TUNNEL LEASES MORE PROPERTY—A lease has been made by the Northwestern University to the Illinois Tunnel Company, of property with a north frontage of 190 feet on the south branch of the Chicago river; 190 feet on the Chicago & Alton Railway right of way on the south; 800 feet on Quarry street on the west, and a slip on the east. The lease is dated September 19, and runs to October 15, 2003. The property contains 118,356 square feet. The rental of $297,000 for the term is as follows: $1,500 in advance October 15, 1904, and $1,500 on the fifteenth day of the months of April and October of each year during the remainder of the term. The lessee is to erect, on or before September 1, 1907, buildings, railway tracks or other fixed improvements costing not less than $100,000. At the end of the term of the lease, the lessor may purchase the buildings, or the lessee shall have an extension of ten years at the same figures.

A NEW DATE SET FOR BRIDGE CARS—It has been announced that tracks will be laid from one end of the new Williamsburg bridge to the other by November 1. Athough this bridge—the first of the new structures designed to relieve the traffic congestion between Brooklyn and New York—was opened to the public on December 19, 1903, it is probable that a full year will have elapsed, before passenger traffic is inaugurated. Contracts have been let, aggregating $400,000, for tracks across the bridge and terminal loops on the New York and Brooklyn plazas. Underground electric lines are being built by the Metropolitan Street Railway Company to connect the Eighth street crosstown line and the Second avenue line with the bridge tracks, so that the Metropolitan company will be able to run its cars through to the Brooklyn plaza when the bridge lines are completed. The Brooklyn Rapid Transit Company expects to run some of its cars to the New York terminal early in December.

TELEPHONE COMPANY TAKES ON TRUST DEED FOR A LARGE AMOUNT—A trust deed of $50,000,000, made by the State Independent Telephone and Telegraph Company of New Jersey to the American Trust and Savings Bank, as trustee, has been filed in Chicago, Ill. The loan obtained is in the nature of a bond issue, and is stated to be for the following purposes: "To acquire, improve, extend, enlarge and develop the property the telephone company has purchased from the Northwestern Telephone Company, of Illinois, and the personal property of said company, upon which property there is an existing bonded indebtedness of $500,000, and the company, as a part of the purchase price of property so acquired, is desirous of redeeming and retiring its bonded indebtedness." The bonds are payable January 2, 1927, drawing five per cent interest. The trust deed is on all the property of the State Independent Telephone and Telegraph Company, which has offices in Jersey City, Chicago and Aurora.

THE TORONTO & NIAGARA POWER COMPANY—The work of building the plant of the Toronto & Ontario Power Company, formed to construct transmission lines from Niagara falls to Toronto, is well under way. The line is eighty-six miles long. The right of way has been purchased for the entire system, and will be eighty feet wide, sufficient to accommodate the rails of the proposed Toronto & Hamilton Electric Railway Company. This right of way will also convey the power cables. Two transforming stations are being erected in Toronto, and cable towers have been

erected as far as Davenport. From Davenport the line will run, in a northwesternly direction, through Toronto Junction to Lambton Mills. From this point it will parallel the Canadian Pacific Railway to Islington, and then run in a direct line west of Clarkson. From this point it will parallel the Grand Trunk Railway to a point north of Bronte, and from here in a direct line to Burlington. The constructing company has secured the consent of the townships of Nelson and Saltfleet to run across the beach, but it is not yet decided whether the line will follow the beach or pass through Hamilton. From Hamilton the line will proceed to a point near Stony Creek, thence up the mountain to the top of the escarpment just beyond Grimsby, and then in a direct line to Niagara falls. A branch line will be constructed from Islington to New Toronto, a distance of about three and one-half miles.

MEXICAN ELECTRICAL NOTES—The company which holds what is known as the Perez concession for the utilization of water-power from the Santiago river, in the state of Jalisco, is making arrangements to transmit electrical energy to the city of Aguascalientes, a distance of about 110 miles. The length of river covered by the concession is about thirty miles, with a variable fall of 670 feet. It is expected that not less than 30,000 horse-power can be developed. W. A. Rogers, of New York, is one of the owners of the concession, and J. M. Garcia, Lazaro Lepetiche and Latour de Vasquez, all of Guadalajara, are primarily interested in the enterprise. The Mexican Railway, known as the "Queen's Own," and one the oldest railroads of the republic, purposes, if consent can be secured from the London officials, to electrify the entire line from Mexico City to Vera Cruz. The overhead trolley system will probably be installed. Mr. Benjamin Barrios, of Mexico City, has obtained from the government a concession for the construction of an electric line from Mexico City to Pueblo. The concession specifies that at least ten kilometres of the road must be built each year, and the first ten within the next twelve months. A deposit of $18,000 was required as a guarantee for the fulfilment of the contract. The line will be used for the carrying of passengers and freight. An American company is making efforts to secure the contract to furnish electric light to Culiacán. This company is stated to have a capital of $100,000, and purposes taking over the old plant and expending a large sum in improving and extending its service. The plant is now owned by Carlos Escovar, and the service, it is stated, is inadequate.

LEGAL NOTES.

CONTRACTS BY TELEPHONE—It has been decided that where the terms of contract are discussed over the telephone, the place of contract is the residence of the party accepting the offer.

FIVE-CENT TELEPHONE JUDGMENTS—The justice courts of Chicago have rendered many judgments against the Chicago Telephone Company for nickels dropped in public stations in cases where connections with parties called are not secured.

RIGHT TO CUT WIRES—The Winnebago County Telephone Company was awarded damages to the amount of forty dollars in a suit which was brought against a building mover who had cut six wires of the company which impeded his progress.

ORDERED TO RESTORE TELEPHONE SERVICE—The New York Telephone Company has been ordered, in a peremptory writ of mandamus by Justice White of the supreme court, Brooklyn, to restore its service to the New York and New Jersey Distributing and Circulating Company.

RESPONSIBILITY FOR SAGGING WIRES—A judgment against the Bell Telephone Company was given recently for damage done to a steamer, the smoke-stack of which was torn off by sagging wires during high water in the river. Suit was brought at the rate of $500 a day and damages were awarded in full.

DUTIES OF TELEPHONE AND TELEGRAPH COMPANIES—In the superior court of Pennsylvania, it has been decided that if the employés of a company mutilate trees on private property, the company may be held responsible and that wires placed on houses without permission, may be removed by the owner.

IN THE CASE of Herbert *vs.* the Lake Charles Ice, Light and Water Company, La., it was held that the duty of an electric light company conveying electricity by overhead wires strung through the streets of a city to keep its wires constantly insulated so as to be prepared to guard against the effect or objects coming in contact with them regardless of the facts and causes which may bring about the contact, is absolute.

TELEPHONE LINES REAL PROPERTY—At the last general assembly of Illinois a law was passed placing the property of telephone companies, especially the lines and poles, under the class of real instead of personal property. Under the former law telephone property, being considered as personal, could not be mortgaged.

RIGHTS OF AN ABUTTING PROPERTY OWNER—In the case of Halloran *vs.* Bell Telephone Company, it was decided by the New York courts that when the owner of land adjoining a highway does not own an interest in the highway, his rights as an abutting owner are not interfered with by the erection of telephone poles along the highway and he can not maintain an action for the removal of the poles.

USE OF THE SAME TELEPHONE NUMBERS—In the suit of the Rocky Mountain Bell Telephone Company *vs.* the Utah Independent Company for an alleged infringement of the copyright law in using the same telephone numbers as adopted by the plaintiff, a demurrer of the defendants was sustained on the ground that the complaint did not set forth the result to the plaintiff in case the defendant did use its numbers. Ten days were accorded in which to amend the complaint.

WHAT IS ODRINARY CARE?—In the case of Cumberland Telephone and Telegraph Company *vs.* Warner, in which the latter was injured by the breaking of a pole on which men were working, it was decided that the employés of the company had not observed the ordinary care required by law. The court defined ordinary care as "that degree of care usually exercised by ordinarily prudent and careful men in like occupations and under circumstances similar to those prevailing in this case. Failure to exercise such care is negligent."

WHEN CAN AN INDIVIDUAL COMPLAIN OF THE ERECTION OF POLES?—The Missouri Court of Appeals in discussing the question: When can an individual complain of the presence of telephone poles? has said, "The erection of telephone poles in the city streets can not be complained of by one not suffering special damage, such erection being authorized by statute or ordinance. Granting that the company has legal right by statute and ordinance, to do business, it is safe against persecution by individuals in all cases where the individual has not a grievance for which he can specially claim damages. If the individual should seek to procure judgment owing to his mere dislike to the erection of poles, he would have to do it through the public prosecuting officers, unless he could prove that their location had caused special damage."

THE RESPONSIBILITY OF OWNERS OF CONFLICTING WIRES—In an action in the circuit court of Chesterfield County, Va., for damages occasioned by fire caused by electricity being carried from a street railway company's wires to the plaintiff's place of business, the street railway company made the defense that as its wires being under those of the telephone company, it was not obliged to erect guard wires, provided the distance between them was sufficient to avoid contact by reason of the sagging of the telephone wires, and the telephone line was properly constructed. The court held that the company was only required to exercise reasonable and ordinary care in this matter and denied the contention that defendant was not responsible because it had secured a prior right in erecting its wires and that the telephone company had placed an additional burden upon it by placing its wires over those of the defendant. The court said that the law presumed that the telephone company, in erecting its line, used all ordinary precautions for making its wires safe. On the question of the duty of companies of this character to furnish modern mechanical appliances, it was said that the burden rested upon the defendant to avail itself of the best mechanical inventions in practical use effectually to prevent injury from its wires coming in contact with the telephone company's.

PERSONAL MENTION.

MR. C. C. MAJOR has accepted the chair of Mechanical Engineering at the University of Oklahoma.

MR. M. J. KINCH, of Holland, Mich., has been appointed superintendent of the interurban line between Green Bay and Kaukauna.

MR. M. B. HERELEY, formerly general superintendent of the Chicago Union Traction Company, has been appointed traffic manager.

MR. A. W. CONNER, a graduate of Purdue University, has been appointed assistant professor of Civil Engineering in the Missouri School of Mines.

MR. C. C. RUTLEDGE, formerly of Thomas F. Smith & Company, has assumed charge of the contract department of the H. W. Johns-Manville Company.

LIEUTENANT ALFRED T. CLIFTON, United States Signaling Service, has been ordered to proceed to Seattle, Wash., for duty pertaining to the Alaska telegraph system.

MR. ROBERT R. HERTZOG has been appointed general superintendent of the Chicago Union Traction Company. Mr. Hertzog was formerly chief supervisor of the company.

PROFESSOR IRA REMSEN, president of Johns Hopkins University, was presented with the gold medal of the Society of Chemical Industry at the annual meeting, held September 8, at Columbia University.

DR. CHARLES B. DUDLEY is the author of a pamphlet, entitled "The Passenger Car Ventilation System of the Pennsylvania Railroad Company," in which is incorporated the study and results of ventilation investigations carried on by that company for a number of years.

MR. T. N. McNAIL, president of the Michigan College of Mines, was elected president of the Society for the Promotion of Engineering at the convention held at St. Louis. Professor Elwood Mead, University of California, was elected first vice-president, and Professor M. S. Ketcham, University of Colorado, secretary.

MR. GEORGE C. MAYNARD, assistant curator of the division of technology, United States National Museum, Washington, D. C., was a visitor to New York last week. Mr. Maynard is a frequent contributor to the technical press, and has acted as special correspondent for many years on matters concerning government developments in engineering.

MR. W. P. JACKSON, superintendent of the Bay City Traction and Electric Company, Bay City, Mich., has resigned this position to become master mechanic of the traction and light properties of the Saginaw Valley Company. Mr. H. C. Morris, superintendent of the Bay City Gas Company, has been appointed superintendent of the Bay City street railway system retaining also his former position.

MR. C. O. BAKER, president of Baker & Company, Inc., platinum refiners and manufacturers, of Newark, N. J., and New York city, who returned last week from an extended European trip, reports that the prices of crude platinum have been very materially affected by the draughting of the laborers from the Ural mines for service in the Russo-Japanese war. Notwithstanding recent advances, a further rise in prices seems almost assured.

ELECTRICAL SECURITIES.

During the past week there was every evidence at hand to demonstrate that the advancing security prices were the result of a sustained belief in the ability of the market to continue its swing upward. Since the nominations of candidates for the presidency for the next four years were announced, the market has picked up, and there is a better feeling than has existed for several months. In fact, it seems as though, within the last week, the whole situation has cleared wonderfully. It is true that there still remains a depression in industrial conditions to offset the prosperity of the agricultural districts. This prosperity of the rural districts, however, coupled with the fact that there is on hand a very large amount of idle money, will force speculation to a considerable degree during the coming winter. A very hopeful indication along with this is the almost simultaneous settling of labor disputes throughout the country, in many cases with satisfaction and to the financial advantage of the workingman. The latest reports from the iron and steel industry show that the recent cut in prices of finished products has stimulated a rather heavy demand, and there is also encouraging news to the effect that, for the first time in some months, demand is in excess of production of raw material. It has been found necessary to open up a number of rolling mills which have been closed or on half-time for some months, and a better prospect is evidenced by the placing of some 30,000 men on full time by the Pennsylvania Railroad. This is significant of the general improvement of carriers throughout the country.

ELECTRICAL SECURITIES FOR THE WEEK ENDING SEPTEMBER 10.

New York:	*Closing.*
Brooklyn Rapid Transit	56⅞
Consolidated Gas	206¾
General Electric	174½
Interborough Rapid Transit	147½
Kings County Electric	182
Manhattan Elevated	157¼
Metropolitan Street Railway	121
New York & New Jersey Telephone	155
Westinghouse Manufacturing Company	164

The New York Stock Exchange has listed $12,823,600 convertible debenture 6 per cent bonds of 1909 for the Consolidated Gas Company. The company's balance sheet, showing its condition at the close of the first half of the present fiscal year, *viz.*, at June 30, 1904, compares as follows: assets, $106,352,704; liabilities, $87,548,369 leaving a surplus of $18,804,335, as compared with $15,264,070 in 1903.

Application has been made to the Stock Exchange to list $2,469,550 additional assenting stock of the Westinghouse Electric and Manufacturing Company.

Metropolitan Street Railway quarterly dividend of 1¾ per cent will be paid October 15. Books close September 24 and reopen October 17.

Commercial Cable directors have declared the regular quarterly dividend of 2 per cent, payable October 1. Books close September 29 and reopen October 3.

A quarterly dividend of 1½ per cent on the capital stock of the Manhattan Railway Company will be paid on and after October 1, 1904, to stockholders of record at the closing of the transfer books September 16. The transfer books will be reopened on Wednesday, September 28.

A dividend of $2 per share will be paid on October 15, 1904, to stockholders of the General Electric Company of record at the close of business on September 17 has been announced.

Application has been made to the Stock Exchange to list $1,250,000 additional capital stock of the Kings County Electric Light and Power Company.

Boston:	*Closing.*
American Telephone and Telegraph	140½
Edison Electric Illuminating	260
Massachusetts Electric	58
New England Telephone	130
Western Telephone and Telegraph preferred	90

August earnings of the Massachusetts electric companies show an increase of $30,000 as compared with last year.

Philadelphia:	*Closing.*
Electric Company of America	9⅜
Electric Storage Battery common	68
Electric Storage Battery preferred	68
Philadelphia Electric	7¼
Union Traction	56½
United Gas Improvement	95

A dividend of $2 a share has been declared on Philadelphia Traction (leased by Union Traction), payable October 1 to stockholders of record on September 10.

Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	148
Metropolitan Elevated preferred	59½
National Carbon common	39
National Carbon preferred	109
Union Traction common	6¾
Union Traction preferred	31

Chicago Telephone directors have declared the regular quarterly dividend of 2½ per cent, payable October 1. Books close September 28 and reopen October 1. The company added 1,018 instruments during August, and now has 112,648 connected.

NEW INCORPORATIONS.

JOPLIN, MO.—Galena Home Telephone Company. $10,000.

ELSMORE, KAN.—The Katy Telephone Company. $2,800.

OAKLAND, CAL.—Vantana Power Company. $500,000.

TOPEKA, KAN.—Arcadia & Drywood Telephone Company. $750.

CONCORD, N. H.—Jefferson Telephone Company. $1,000.

MANNING, IOWA—The Manning Telephone Company. $21,000.

CONCORDIA, KAN.—The Home Light and Power Company. $50,000.

COUNCIL GROVE, KAN.—Council Grove Telephone Company. $30,000.

ARIEL, PA.—The Wayne & Lackawanna Telephone Company. $8,000.

ST. PAUL, MINN.—The Farmers' Mutual Telephone Company. $20,000.

ELGIN, NEB.—Antelope County Mutual Telephone Company. $60,000.

LANSING, MICH.—Manistique Light and Power Company. $100,000.

RALEIGH, N. C.—The Franklin Telephone and Electric Company. $15,000.

LANSING, MICH.—Adrian & Ann Arbor Electric Railway Company. $300,000.

FRANKFORT, KY.—Calloway County Independent Telephone Company. $1,000.

GUTHRIE, OKLA.—The Northwestern Telephone Company. $5,000. Incorporators: S. M. James and others.

MADISON, WIS.—Union Grove & Paris Telephone Company. $2,000. Incorporators: Henry Baens and others.

TALMA, IND.—Talma Telephone Company. $5,000. Incorporators: S. J. Grove, L. Grove and Omar C. Montgomery.

CHICAGO, ILL.—Star Line Telephone Company. $100,000. Incorporators: H. H. Knippe, J. S. Abbott, A. L. Maxwell.

BICKNELL, IND.—Citizens' Telephone Company. $10,000. Incorporators: Riley H. Pickel, John Phillippe, Harmon Buck.

CHICAGO, ILL.—Cedarville Home Telephone Company. $7,000. Incorporators: S. W. Roberts, H. M. Fisk and S. F. Newhall.

HIMRODS, N. Y.—Himrods Telephone Company. $2,000. Incorporators: C. M. Van Dyke, E. P. Porter, H. S. Voorhees, Himrods.

HARRISBURG, PA.—Bethel Telephone Company. $5,000. Incorporators: W. T. Phillips, J. P. Wilson and others, Finleyville.

ALTON, ILL.—Alton Gas and Electric Company. $500,000. Incorporators: Charles A. Caldwell, George M. Ririe, Levi Davis.

MACON, GA.—The Piedmont Power Company. $10,000. Incorporators: R. L. McCalee, A. J. Warner, W. A. Carlisle and others.

SOUTH BEND, IND.—Economy Electric Corporation. $10,000. Directors: Ulysses S. Meeks, C. M. Meeks and William F. Wood.

ROCKLAND, MASS.—The Plymouth County Street Railway Company. $125,000. Incorporators: C. F. Remington and others.

SEWARD, PA.—Seward Heat, Light and Power Company. $5,000. Directors: D. B. Anderson, Alex Kerr, Bert Wagner, Seward.

CHEAPSIDE, TEX.—Cuero & Cheapside Telephone Company. $5,000. Incorporators: J. E. Lord, J. F. Elder and C. F. Carson.

SPRINGFIELD, ILL.—The Rose Township Telephone Company. $100. Incorporators: Phillip Roessler, George Ruff and Jacob Kull.

KIRKLAND, ILL.—Farmers' Union Telephone Company. $2,500. Incorporators: William Van Wert, John Paulson and W. N. Thompson.

WASHINGTON, D. C.—Home Telephone Company. $300,000. Incorporators: George H. Corey, Eugene Schooley and J. L. Cohencious.

JASPER, ALA.—Jasper Water, Light and Power Company. $50,000. Incorporators: L. W. Lollar, J. M. Cranford, D. K. Cartler and others.

CHICAGO, ILL.—Van Buren Electric Light Company. $50,000. Incorporators: Howard D. Malse, Thomas F. Low and Harold M. Dewar.

SOUTH CHINA, ME.—China Telephone Company. $10,000. President, W. J. Thompson, South China; treasurer, F. B. Foye, China, Me.

FAIR HAVEN, N. Y.—Sterling Telephone Company. $960,000. Directors: F. B. Phillips, Frank Longley and Herbert Grant, of Fair Haven.

DEPOSIT, N. Y.—Sherman & Hale Eddy Telephone Company. $700. Incorporators: E. A. Bronson, W. O. Curtis, J. Gordinier, all of Sherman, Pa.

NEEDHAM, MASS.—Charles River Power Company. $50,000. President, W. H. Burgess, Somerville; treasurer and clerk, F. H. Brown, Wellesley.

HALLSVILLE, OHIO—The Colerain Telephone Company. $10,000. Incorporators: P. D. Robinson, A. S. Haag, A. H. Clark, T. P. Syloan and E. A. Reed.

BLAINE, ME.—Aroostook Farmers' Telephone and Telegraph Company. $100,000. President, F. A. Hatchett, Blaine; treasurer, H. O. Hussey, Blaine.

ARLINGTON, TEX.—Arlington Light and Power Company. $10,000. Incorporators: William Dugan, W. C. Weeks, W. L. Sweet, F. A. Hodd and A. W. Collins.

TORONTO, ONT.—Strathcona Light and Power Company. $300,000. Incorporators: F. J. A. Davidson, C. A. Stone, D. A. Dixon, J. F. Herbert and James Bishop.

GUTHRIE, OKLA.—Dryden Telephone Company, of Dryden. $1,100. Incorporators: J. S. Campbell, L. D. Perry, J. S. Wilkins, J. D. DeLamar and I. F. Shrewer.

WASHINGTON, D. C.—The National Electric Power Company, of Mexico. $5,000,000. Incorporators: P. H. Burch, Ralph Wormelle, D. F. Pearce and R. K. Van Mater.

AUSTIN, TEX.—Greenville Power and Manufacturing Company. $15,000. Incorporators: M. R. Graham, A. E. Edwards, G. W. Raum and W. H. Goolsby, all of Greenville.

CAMDEN, N. J.—Monterey Electric Railway, Light and Power Company. $225,000. Incorporators: William T. Wheeler, E. F. Walker, T. H. Beckett, all of Camden.

COLUMBUS, OHIO—The Girard Telephone Company. $35,000 Incorporators: E. N. Sotze, J. C. Koehl, E. L. Huser, S. C. Hazen, J. C. Jones, W. J. Wallis and R. T. Izant.

HARRISBURG, PA.—The Farmers' Mutual Telephone Company. $30,000. Directors: S. N. Hopper, J. R. McPherson, E. K. McConnell, C. M. Linn, H. H. Bebout and others.

LOS ANGELES, CAL.—The Bernard Light and Heat Company. $100,000. Directors: D. Barnard, Bakersfield; A. L. Baker, Pasadena; J. E. Jean, R. Hynes, L. R. Myers, Los Angeles.

SPOKANE, WASH.—Nez Perce Water and Power Company. $100,000. Incorporators: Z. A. Johnson, Stephen Johnson, C. W. Lewis, J. L. Harris and T. W. Englehorn, all of Nez Perce.

MILWAUKEE, WIS.—The Ridgeway, Jonesdale & Hollandale Telephone Company. $2,000. Incorporators: P. A. Peterson, Thomas Convey, Robert F. Brunker, William Kramer and Even Jutson.

DAVENPORT, IOWA—Moline & Kankee Electric Railway Company. $100,000. Incorporators: W. R. Burleigh, LaGrange; Gideon N. Thompson, Berwyn; H. Hamill, W. J. Gilbert and E. P. Green, Chicago.

TRENTON, N. J.—Atlantic-Pacific Street Railway and Surety Company. $200,000. Incorporators: R. R. Robinson, D. J. Huger, Michael J. McTiernan. The company is to operate a street railway in Florida.

INDIANAPOLIS, IND.—Vernon Electric Light and Power Company. $5,000. Directors: J. H. Purdy, H. R. Lynn and William K. Dunbar, of Pittsburg, and Robert D. Morris and G. V. Menzies, of Mt. Vernon.

ALLENTOWN, PA.—Allentown & Reading Street Railway Company. $30,000. Incorporators: H. E. Ahrens, G. B. Schaefer, Reading; S. K. Hoffman, Peter L. Diener and Frank R. Wagner, of Hamburg, and others.

CAMDEN, N. J.—Telegraph Company; objects, to maintain and operate telephone and telegraph lines. $100,000. Incorporators: U.

N. Bethel, James E. Mitchell, Theodore Spencer, Winifred S. Piersol and H. T. Ettinger.

BELLEVILLE, ILL.—Illinois Illuminating Company. To furnish light, heat and power for East St. Louis, St. Clair and Madison counties. $50,000. Incorporators: C. E. Harris, George F. McNulty and E. G. Bruckman.

ST. PAUL, MINN.—Henderson Telephone Company. Incorporators: Hans Ems, W. H. Leeman, Lionel A. Guilbert, John F. Dempsey, Philip J. Hemler, Alois W. Heberle, August Ney, Alfred C. Blasing and William N. Theissen.

NEW YORK, N. Y.—Alaska Telephone and Telegraph Company. $100,000. Directors: A. S. Boyd, of Nome, Alaska; W. H. Duval, E. D. Church, J. N. Emanuel, Jr., P. V. R. Van Wyck, W. M. Lovering, A. C. Sherstone, W. N. Harding, Jr., W. B. Hough and John Engles, of New York city.

BANGOR, ME.—North Penobscot Telephone Company, to construct and maintain telephone lines in the towns of Kingman, Prentiss and Carroll, Springfield and Lakeville plantation, all in Penobscot County. $5,000. Officers: president, Henry Osgood, of Kingman; treasurer, Wm. A. Blanchard, of Carroll.

HUNTINGTON, TENN.—The Consolidated Telephone and Telegraph Company. To operate lines in Perry, Wayne, Hardin and adjoining counties. $50,000. Incorporators: J. K. Barlow, of Savannah; T. S. Hughes, of Clifton; F. E. Schwab, of Nashville; H. E. Stubblefield, of Densons, and W. N. Sloan, of Linden.

ALBANY, N. Y.—The Delaware & Schoharie Telephone Company, to establish a line from Stamford, Delaware County, to South Jefferson, Jefferson, Blenheim, Ruth, Gilboa, South Gilboa and other places in Schoharie County. $2,000. Directors: H. P. Hubbell and E. W. Landon, of Stamford, and E. P. Jones, R. H. Champlin, of Ruth, and others.

ELECTRIC RAILWAYS.

HUNTSVILLE, ALA.—A movement has been begun to build an electric line from the city to the top of Monte Sano.

YORK, PA.—Work has been begun on a trolley line to connect Danville and Sunbury, a distance of about thirty-six miles.

ALLENTOWN, PA.—Work has been commenced on the Adamstown & Mohnsville road. The line will be entirely rebuilt.

ELK POINT, S. D.—Capitalists are agitating the building of a trolley line between Sioux Falls and Egan, and from Egan to Brookings.

BALTIMORE, MD.—Work has been started on the Middletown & Cecilton trolley line, materials and supplies now being delivered along the proposed route.

UTICA, N. Y.—The last or northern link of the Oneonta, Cooperstown & Richfield Springs Electric Railway, which runs from Mohawk to Oneonta, has been opened. The track extends from Mohawk to Richfield Springs.

NEW ORLEANS, LA.—It is reported that the New Orleans Railways Company had signed a contract for the construction of a new power-house. The plans, it is said, call for the construction of a brick building to cost $50,000.

DECATUR, NEB.—It is rumored that work will begin at once on the proposed electric road between this city and Tekamah, a distance of eighteen miles. All of the right of way has been secured, and no obstacle now lies in the way of its immediate construction.

HARTFORD, CT.—The Consolidated Railway Company, the New York, New Haven & Hartford's traction holding company, will soon begin building a line from Central Village to Norwich, forming a continuous line from Worcester, Mass., to New London, paralleling the New London & Northern.

LANSING, MICH.—The Bay City & Caro Railway Company has filed articles of incorporation with the secretary of state. The company proposes to build an electric railway from Bay City to Caro, a distance of thirty-two miles. It has a capital stock of $30,000. Fred Slocum, a newspaper man at Caro, is one of the incorporators.

SAN FRANCISCO, CAL.—The Northern California Counties Electric Railway and Steam Line has been organized for the purpose of building an electrical line to connect Marysville, Oroville and Colusa and of establishing a line of steamboats to connect with the electric road for the handling of freight between valley points and this city.

DETROIT, MICH.—Walter C. Nelson, president of the Northern Traction Company, of South Bend, Ind., has filed a mortgage of $3,400,000 to the Knickerbocker Trust Company, of New York, and Benjamin L. Allen, New York, co-trustee. The mortgage covers a proposed electric car line to extend from South Bend to Chicago through New Carlisle, Laporte, Valparaiso and Hammond, Ind.

NEWARK, N. J.—The Delaware Traction Company has been granted a franchise by the Hanover township committee to run a trolley line from Collinsville, through Malapardis, Whippang and Hanover to Cook's bridge, the dividing line between Morris and Essex counties. The route includes eight miles of township roads. It is thought that the company will connect with the Public Service lines at West Orange or Singac.

ALTON, ILL.—President J. F. Porter, of the Alton, Granite & St. Louis Traction Company, says that auxiliary power stations will be established at Granite City and Edwardsville Crossing to furnish power for the electric line. The main power plant will be at the Alton station, which must be enlarged. The necessary machinery has been ordered, and in addition to the machinery orders have been placed for the passenger coaches.

PITTSBURG, PA.—Engineers are at work surveying routes for a new trolley line extending from Library to Clairtom. The line is backed largely by leading manufacturers and others interested in the real estate business in Clairtom. At Library the new line will connect with the present line from Pittsburg to Charleroi, thus giving a through service to Pittsburg. The new road will enter Pittsburg through the Smithfield street tunnel.

POTTSTOWN, PA.—The Pottstown & Reading Street Railway Company has succeeded in having an ordinance passed in the borough council for the use of the streets for a trolley line, which will be the connecting link between Reading and Philadelphia. The promoters intend building a stretch of line eight miles in length between Pottstown and Birdsboro. At present there is a line from Pottstown to Philadelphia and from Birdsboro to Reading.

LANCASTER, PA.—The charter of the Lancaster, Rohrerstown & Mount Joy Electric Railway Company has been received at the recorder's office. This company is a merger of the Lancaster & Rohrerstown and the Lancaster & Mount Joy Electric companies. The capital stock is $400,000, nearly all of which is subscribed. The road will run from this city to Rohrerstown, thence to the Harrisburg turnpike to Mount Joy. Elizabethtown will be the terminus.

CORPUS CHRISTI, TEX.—It is said that a contract has been signed for the construction of the St. Louis, Brownsville & Mexico road from Robstown to Bay City, through Refugio and Palacido, a distance of 144 miles. The construction work is to be done by Johnston Bros., who built the Brownsville branch and who are now at work on the Hidalgo branch. Grading and track-laying will start from Bay City. It is said work will be started at various points along the located line as soon as possible.

PATERSON, N. J.—Records in the courts here and at Hackensack indicate that the State Line Traction Company has acquired enough property in Passaic, Sussex and Warren counties to complete a trolley line from this city to Suffern, N. Y. The line is to be used almost exclusively for the transportation of milk from places in these counties and in Orange and Rockland counties, N. Y., to Paterson and thence by the Hudson River Trolley Company to New York. This is following out an idea that has been successfully tried in some western states by the men who have formed the State Line Traction Company. Eventually, it is said, the line will be run to Easton, Pa.

NASHVILLE, TENN.—The secretary of state has granted a charter to the Cambria Southern Railway, with main offices in Knoxville, and capitalized at $100,000. The incorporators are: J. H. Ringgold, H. W. Oliver, W. L. Pomeroy, J. B. Wright and J. H. Frantz. The new road will extend from Cave Creek, on the Atlanta, Knoxville & Northern Railway to points and railway connections in Georgia, crossing the state line in Polk County near the Conesauga river. A charter has also been granted to the Mentor Southern Railway, with a capitalization of $50,000 and incorporators identical with those of the Cambria Southern. This road will extend from Mentor, on the Atlanta, Knoxville & Northern Railway and connect with the same road at Vonore, in Monroe County.

ELECTRIC LIGHTING.

MINNEAPOLIS, MINN.—Shell Lake will put in its own lighting plant.

BRIGHTON, ALA.—The city contemplates establishing an electric light plant.

AFTON, IOWA—The town voted to install a new electric light plant at a cost of $4,500.

UTICA, N. Y.—The Utica Electric Light and Power Company has extended its line to Oriskany.

WASHINGTON, N. J.—A new $30,000 electric light plant has been completed in the Borough of Sussex.

YORK, PA.—The $2,000,000 plant of the York Haven Water and Power Company has been placed in operation.

SIOUX CITY, IOWA—The Sioux City Gas and Electric Company will improve its system at a cost of $20,000.

ALTOONA, PA.—The Edison Electric Light Company has begun erecting poles on which to string wires to Llyswen.

NEWARK, N. J.—The Millburn Electric Company has begun the extension of its street lighting system in Springfield.

TREMONT, ILL.—The Electric Light and Power Company has secured a new franchise from the village board for ten years.

FORT COLLINS, COL.—The Larimer Light and Power Company is expending about $10,000 in making improvements to its plant.

CAMILLA, GA.—The city contemplates issuing $20,000 of bonds for the construction of waterworks and acquiring the electric light plant.

BOSTON, MASS.—The annual report of the Niagara Falls Power Company for the year ending June 30, 1904, shows a surplus of $159,038.

WATERBURY, CT.—It is said that the Woodbury & Southbury Electric Railway Company will operate an electric lighting plant in Woodbury.

FAIRMOUNT, IND.—At a meeting of the town council a contract was awarded to the Larue & Patterson Electric Light Company for street lighting.

PLAQUEMINE, LA.—The town has granted a franchise to the Ewing-Merkle Electric Company, St. Louis, Mo., for the erection of an electric light plant.

HANNIBAL, MO.—The contract for the machinery to be installed in the municipal electric plant has been awarded to the Westinghouse company.

MUNCIE, IND.—Extensive improvements are being considered for the betterment of the street lighting of the city by the electric light committee of the council.

ATHENS, GA.—The Athens street railway has received the machinery and equipment necessary for the installation of the new electric light system in Athens.

KISSIMMIE, FLA.—The building committee has completed the plans and specifications for the new building for the electric light plant, and is ready to receive bids.

WICHITA FALLS, TEX.—The electric light plant has changed hands. M. Lasker, I. H. Kempner, D. W. Kempner, R. C. Malone and Henry Sales are the purchasers.

NEW IBERIA, LA.—This city has closed a contract for an entire new system of arc lights with Gates & Company, of New Orleans, to form part of the present electric light system.

SIOUX CITY, IOWA—Plants which will furnish electric light, steam, heat and power to patrons in Sioux City and costing $150,000, are proposed by the Armour and Swift interests.

THOMSON, GA.—The contract for the construction of the electric light plant for Thomson has been let to the Electric Supply Company, of Savannah, Ga. The cost will be about $9,500.

CENTRALIA, MO.—At a special election held in this city to vote a ten-year franchise to P. H. Baldridge to run an electric plant, the proposition was carried by more than a two-thirds majority.

READING, PA.—All of the material for the electric light plant at Rutherford has been delivered and it will be erected within the next few weeks. The current will be supplied from Harrisburg.

LEBANON, IND.—The Citizens' Electric Light and Ice Company, owned by R. A. Edwards & Son, of Peru, has been granted a franchise for twenty-five years and a ten years' contract for city lighting.

SUFFIELD, CT.—The Suffield Lighting Company has signed a contract to furnish street lights for the towns of Agawam, Mitteneague and Feeding Hills, and is now at work constructing the line.

ZANESVILLE, OHIO—An ordinance authorizing the service board to make a one-year lighting contract with the Zanesville Street Railway, Light and Power Company has been passed by the city council.

ROCHESTER, N. Y.—The plant and real estate of the Consolidated Gas and Electric Company, of Batavia, has been sold at auction to Seth W. Warren, of Buffalo, representing the bondholders, for $35,000.

HAMMONTON, N. J.—The Hammonton & Egg Harbor City Gas Company has purchased the electric lighting plant here from the Atlantic County Electrical Company. The gas company will merge the two companies.

ENNIS, TEX.—At a meeting of the city council a contract was closed with the Ennis Light and Power Company by which the city is to be better lighted than heretofore and the lights are to be kept burning all night.

BURLINGTON, VT.—The municipal lighting plant, recently contracted for, will consist of two units, each of which is capable of supplying 225 arc lamps of 200 candle-power or 2,000 incandescent lamps of sixteen-candle-power.

CEDAR RAPIDS, IOWA—The Cedar Rapids & Iowa City Railway and Light Company has closed a contract for a 1,350-horse-power cross-compound engine, with an 800-kilowatt generator, to be installed in its plant in this city.

GREELEY, COL.—The Greeley electric light plant has been sold to H. C. Watson, Charles Wheeler, Joseph Woolf, Asa Sterling, W. M. Boomer, Albert Igo, I. Rothschild, William Mayher, H. D. Parker and J. C. Mosher, all of them Greeley men.

HARTFORD, CT.—Thomas C. Perkins, of this city, has acquired control of the Windsor Locks Electric Light Company and will take possession of the plant about January 1. Mr. Perkins recently disposed of the Mystic Electric Light Company.

TORONTO, CAN.—Plans will shortly be filed at the Crown Lands Department for the new power development plant which the Backus-Brooks syndicate will erect at Fort Francis. It is estimated that between 15,000 and 20,000 horse-power can be developed.

SOUTHAMPTON, N. Y.—At a special meeting of the stockholders of the Suffolk Light, Heat and Power Company it was decided to authorize the purchase of the property and franchises of the Southampton Electric Light Company at a price not to exceed $13,000.

LARAMIE, WYO.—At a special meeting of the Laramie city council a franchise for an electric light plant was granted to H. D. McCutcheon and J. D. Broyles, of Pittsburg, Pa. A contract was also made with the same parties for lighting the streets. The franchise is for a term of thirty years and the contract for a period of ten years from August 10, 1904.

VIRGINIA, NEV.—The company incorporated last spring to construct a large electric plant in Alpine County and furnish light and power for Gardnerville, Carson and this city, has secured the backing of Pennsylvania capital, and it is announced that work upon the power plant will begin shortly.

RALEIGH, N. C.—A force of men is at work building the concrete dam, eighteen feet high, across the Cape Fear river at Buckhorn falls, thirty miles south of here, which is to develop 8,000 horse-power, for use at Fayetteville. The dam will be 1,500 feet long, and will reach from cliff to cliff.

CODY, WYO.—A company financed by Denver and eastern capitalists will soon undertake the construction of a plant at the falls of

the government dam being built on the Shoshone river. Power will be generated for a smelter and will also be transmitted to the mines at Kirwin. The plans of the company are broad in their scope and include the construction of an electric line from Cody to Sunlight, Kirwin and the Yellowstone National Park.

DENVER, COL.—The Northern Colorado Light and Power Company has been incorporated with a capitalization of $500,000. The company plans to furnish power to mines, and for lighting towns and furnishing power to street railways in towns in Routt and other counties traversed by the Moffat road. The affairs of the concern are in the hands of three directors: Rodney Curtis, Charles M. Hobbs and Loren Curtis.

CHARLOTTE, N. C.—The city is now illuminated by electric power generated on the Catawba river near Fort Mill, S. C., eighteen miles distant. The power is furnished by the Catawba Power Company at $54 per year per lamp, against $87.50, the price formerly paid. The company will also supply power for manufacturing enterprises and private lighting. The power plant cost upward of $1,000,000 and required about five years to construct.

HIBBING, MINN.—The village has closed a deal for the delivery of a new engine and dynamo, in furtherance of the plan to establish a day circuit and reduce the cost of electric lights. The present equipment consists of a Corliss engine of 450 horse-power, a dynamo of 4,500-light capacity, and a battery of three boilers. The council will install in addition to the present machinery a duplex compound engine of 175 horse-power and a 110-kilowatt dynamo of 2,500-light capacity.

TELEPHONE AND TELEGRAPH.

FARGO, N. D.—A new telephone line is to be built west of New Rockford.

WALDO, OHIO—The Marion County Telephone Company is soon to build a plant at Waldo.

BINGHAMTON, N. Y.—A farmers' telephone line is to be erected from Marathon to Texas valley.

DUNWOODY, GA.—A telephone line from Roswell to Dunwoody has been established by the Bell company.

DETROIT, MICH.—The Bell Telephone Company will soon commence the installation of a new system in Windsor.

EL PASO, TEX.—The Independent Telephone Company, it is authoritatively announced, will be in operation by December 1, 1904.

ZANESVILLE, OHIO—The Bell Telephone Company is arranging to build a line from the river to Brush Creek to Cannelsville and Stovertown.

WEST CHESTER, PA.—The Delaware & Atlantic Telephone exchange, of this place, is to be connected with Glen Riddle, a trunk line being erected to that place.

MILWAUKEE, WIS.—The Badger Telephone and Telegraph Company will have a toll line in operation between Racine and the Mississippi river by November 1. The right of way has been secured.

CINCINNATI, OHIO—The Home Telephone Company, of Dayton, Ohio, has voted to increase its preferred stock from $400,000 to $600,000, the new stock to retire $200,000 of the $450,000 outstanding bonds.

LYNCHBURG, VA.—W. R. Doss, of Welch, W. Va., has secured a contract with the water department of Lynchburg to erect a telephone line twenty-five miles long to the site where it is proposed to secure water for the city.

RICHMONDVILLE, N. Y.—A new telephone line is being erected between South Jefferson and Gilboa by S. J. Pierce, of South Jefferson, and C. O. Peaslee, of Ruth. It is expected that the line will be completed and in operation in a few weeks.

BUTLER, PA.—The People's Telephone Company has been re chartered with a capital of $50,000 with the following board of directors: president, John Younkins; secretary, Marion Henshaw; treasurer, Thomas Shufflin; John V. Ritts and Albert L. Reiber.

READING, PA.—The Pennsylvania Telephone Company has completed its new line between Hamburg and Kempton. It passes through Windsor Castle, Lenhartsville, Dreibelbis station and Klinesville, and terminates at Kempton, covering a distance of about seventeen miles.

DES MOINES, IOWA—The Manning Telephone Company, of Manning, Carroll County, has incorporated with a capital of $21,000. Its officers include W. B. Swaney, president; Philip Zerwas, secretary and manager, and R. R. Williams, treasurer. The officers also constitute the board of directors.

MANCHESTER, N. H.—The Henniker Telephone Company has completed its organization and adopted by-laws. The following are the officers: president, George H. Sanborn; clerk, C. B. Childs; directors, George H. Sanborn, Dana E. Huntington, W. O. Folsom, L. W. French and Elwin Bacon.

YOUNGSTOWN, OHIO—Extensive improvements to its equipment in this city will be made by the Central Union Telephone Company. Approximately nine miles of new cable will be added to the company's outside equipment. The greater portion of it will replace the present iron wire circuits.

ALLEGAN, MICH.—The West Michigan Telephone Company, of this city, owned and operated by Major Cornwell and M. D. Owen, has been turned over to the Citizens' Telephone Company, of Grand Rapids. It operated 500 telephones in Allegan and vicinity. Many improvements will be made. Two copper wires will be strung from here to Grand Rapids immediately. The deal was made some time ago.

LYONS, N. Y.—The Wayne-Monroe Telephone Company has filed a certificate for extension of its lines at the county clerk's office. The lines as extended will cover Wayne County and Monroe County as far as West Rochester. A line will be run through Ontario County and Cayuga County to Auburn, connecting all intermediate points as far south as Geneva. From Auburn a line will run through Weedsport and Onondaga County to Syracuse. Another line will extend from Wolcott through Fair Haven to Oswego, covering all intervening villages. The certificate calls for rights of way along the principal highways, with spurs or extensions to such other points as are necessary.

ENGINEERING SOCIETIES.

THE INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA—The annual meeting of the Independent Telephone Association of Southern Indiana will be held at Rockport, Ind., Monday and Tuesday, September 26 and 27, 1904. The present officers of this association are C. D. Knoefel, president, New Albany; L. G. Davis, vice-president, Salem; E. W. Pickhardt, secretary, Huntingburg; T. M. Thom, treasurer, Lamar.

THE AMERICAN RAILWAY, MECHANICAL AND ELECTRICAL ASSOCIATION—An important matter which is under consideration by the executive committee of the American Railway, Mechanical and Electrical Association is the question of so extending the scope of the association as to admit as members superintendents of the way department. It is understood to be the judgment of the executive committee that if the superintendents of the way department prefer to combine with American Railway, Mechanical and Electrical Association, rather than to form a separate organization, action should be taken by the association at this year's convention. Notice has been given under date of September 10, so that there might be thirty days' consideration of this matter in advance of the next regular meeting.

THE INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION—The annual convention of the Interstate Independent Telephone Association will be held in Chicago, Ill., December 13, 14 and 15, 1904. This convention will probably be the most important in the history of independent telephony. The special committees appointed at the last convention, and empowered to act on questions of vital importance, have worked diligently throughout the year, and their reports at the next convention will be very conclusive, and will show that a great deal of work has been accomplished for the independent movement. The present officers of the association are: Henry A. Barnhart, president, Rochester, Ind.; E. H. Morton, vice-president, Minneapolis, Minn.; E. M. Coleman, secretary, Louisville, Ky.; E. B. Conklin, treasurer, Aurora, Ill.

INDUSTRIAL ITEMS.

THE HANCOCK INSPIRATOR COMPANY, New York, has issued a circular descriptive of the Hancock type "E" inspirator.

THE C. W. HUNT COMPANY, New York city, describes in catalogue 046 electric hoists, winches and capstans for direct and alternating currents.

MESSRS. HARVEY FISK & SONS, bankers, announce their removal to their new building, 62 and 64 Cedar street, New York city. Their telephone number is 5000 John.

THE STERLING ELECTRIC MANUFACTURING COMPANY, Warren, Ohio, has mailed to the trade some very attractive literature regarding Sterling special lamps.

THE ABNER DOBLE COMPANY, San Francisco, Cal., has reprinted and distributed a thesis by H. C. Crowell and G. C. D. Lenth, entitled "An Investigation of the Doble Needle Regulating Nozzle."

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., describes in bulletin No. 3059, two types of electric sewing machine motors, applicable to any of the types of machines in present use.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., has mailed to the trade a circular, which is at the same time a blotter, and a calendar for the current month. Incidentally "Holoshade" sockets are mentioned.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., has issued the September number of "Graphite." It contains a number of good views of structures on which Graphite paints have been successfully used.

THE CHAPMAN VALVE MANUFACTURING COMPANY, Indian Orchard, Mass., has issued an invitation to delegates to the New England Water Works Association's twenty-third annual commencement, to visit its works.

THE NORTHERN ELECTRIC MANUFACTURING COMPANY, Madison, Wis., is circulating a leaflet showing the Northern spherical motor direct-geared to a sixteen-inch Ideal engine lathe, the latter built by the Springfield Machine Tool Company, Springfield, Ohio.

THE UNION SWITCH AND SIGNAL COMPANY has issued bulletins No. 19 on circuits for power distant signals, power indicators and annunciators, and No. 20 on automatic block signaling—the polarized or wireless track circuit system. These bulletins contain hints of use and interest to signal engineers and others engaged in the maintenance of signaling systems.

THE GOULD STORAGE BATTERY COMPANY, New York, has closed contracts for storage batteries with the City and Suburban Railway Company, Portland, Ore., the Edison Electric Illuminating Company, Topeka, Kan., the Leominster, Shirley & Ayer Street Railway Company, and the corporation of the town of Port Arthur, Port Arthur, Canada; also with a number of isolated private plants.

MESSRS. DODGE & DAY, Philadelphia, Pa., have been commissioned to assume charge of the electrical installations on the property recently purchased by Alexander Brothers in Philadelphia. A generator will be required as well as several motors, switchboards, shafting and so forth. Dodge & Day will install a night set for the new plant of the Jeanesville Iron Works Company, Hazleton, Pa., and construct a transmission line to Jeanesville to furnish illumination for the town.

THE LOMBARD GOVERNOR COMPANY, 36 Whittier street, Boston, Mass., is distributing two new bulletins, Nos. 101 and 102, respectively. Bulletin No. 101 describes and illustrates hydraulic relief valves, and bulletin No. 102 describes the St. Louis exhibit of the Lombard Governor Company. This exhibit is located in block 42, Machinery Hall. The water-wheel governor shown regulates the speed of a combined exhibit, consisting of an electric generator built by the Crocker-Wheeler Company, Ampere, N. J., which is driven by an ellipsoidal, tangential water-wheel built by the Abner Doble Company, of San Francisco, Cal.

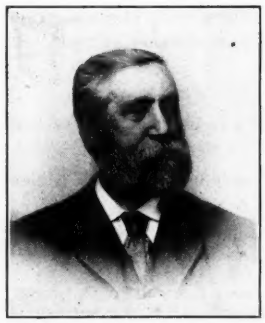
OBITUARY NOTICES.

MR. A. J. CORRIVEAU died on August 6 from injuries sustained from a street car accident on the same day. Mr. Corriveau, who was in his sixty-second year, was one of the first promoters of electrical street railways in Montreal.

MR. JOSEPH O. PROCTOR, a prominent resident of Gloucester, Mass., died suddenly on September 5. Mr. Proctor was vice-president of the Gloucester Electric Company, and a director in a number of other business enterprises in Gloucester.

DR. HENRY PALIN GURNEY was killed at Geneva by a mountain accident, the exact nature of which will never be known. He left his hotel alone and was not missed for twenty-four hours. He was probably caught in a storm, the accident resulting in his death. Dr. Gurney was for ten years the president of, and professor of mathematics in, the Durham College of Science at Newcastle.

MR. CLARK CARYL HASKINS died at his home, 682 West Adams street, Chicago, Ill., on Friday, September 2. Mr. Haskins was one of the pioneer electricians, and was a well-known figure in the electrical field throughout the country. He was born in Buffalo, N. Y., on November 22, 1827, and was one of the earliest workers on the telegraph line, being placed in charge of the Buffalo office of the line constructed between Lockport and Buffalo, N. Y., in 1844. He was at one time manager of the Bain line office at Troy, N. Y. Mr. Haskins was selected in 1878 to represent Professor Elisha Gray in exhibiting electrical devices in telegraph and telephone development at the Paris Exposition. At the close of the exhibition he exhibited and operated this apparatus before the English Society of Electrical Engineers. Returning to Chicago, he was made electrician and manager of the American District Telegraph Company, under L. B. Firman, operating the Edison telephone system. He was probably most popularly known for his work in connection with the multiple switchboard. He was appointed the first electric light inspector of Chicago, after the passage of the ordinance in December, 1883. He was the author of "Reminiscences of an Electrical Inspector," and has contributed a number of papers on electrical topics to the technical press, and was the Chicago correspondent of the ELECTRICAL REVIEW for a number of years. In 1853 Mr. Haskins married Miss Helen M. Smith, of Monroe, Mich., whom he survived three years. His two sons, Frank C. Haskins, of the Illinois Trust and Savings Bank, Chicago, and Dr. G. W. Haskins, of Chicago, survive him. The funeral services were conducted at his Chicago home on September 4, and the interment was at Oakwoods cemetery.



MR. C. C HASKINS.

EDUCATIONAL.

THE PHI BETA KAPPA SOCIETY—The Phi Beta Kappa Society held its eighth triennial council at Saratoga and elected the following officers: president, John A. Dermer, Schenectady, N. Y.; vice-president, E. B. Parsons, Williamstown, Mass.; secretary and treasurer, Oscar M. Voorhees. Charters were granted to ten colleges and universities.

STEVENS INSTITUTE OF TECHNOLOGY—The annual catalogue of the Stevens Institute of Technology, Hoboken, N. J., has been issued. The introduction contains a chapter on the general scheme of instruction. This is carried on through the following departments: mathematics and mechanics, physics, engineering, chemistry, shop-work, mechanical drawing and designing, English and logic, modern languages, experimental engineering, electrical engineering, engineering practice, and business engineering. There are given a number of specimens of entrance examination papers, and a number of fine half-tone illustrations show to advantage the equipment of the various departments of this school of mechanical engineering.

List of Electrical Patents Issued Last Week

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED SEPTEMBER 6, 1904.

769,195 Brush-holder for electric generators; L. R. Smith, Pendleton, Ind.

769,203 Electric signal; W. T. Wheeler, St. Louis, Mo.

769,214 Block switch and signal system for electric railroads; T. F. Gaynor, Brooklyn, N. Y.

769,228 Electric circuit-closer; J. K. Nostrom, Chicago, Ill.

769,236 Electrode holder for electric headlights; M. A. Ross, Chicago, Ill.

769,250 Electric furnace; M. R. Conley, New York, N. Y.

769,273 Enclosed electric-arc lamp; H. C. F. Petitdidier, Paris, France.

769,279 Apparatus for signaling to trains; J. Seel, Manchester, England.

769,303 Means for supporting electrical lamps; W. B. Churcher, Cincinnati, Ohio.

769,304 Telephone; W. B. Churcher, Cincinnati, Ohio.

769,306 Telephone or telegraph system; F. E. Denzer, Everett, Wash.

769,342 Method of regulating alternating-current generators and circuits; L. Gutemann, Peoria, Ill.

769,364 Pyrometer; H. M. Tory, Montreal, Canada.

769,403 Secondary or storage battery; C. Potter, Philadelphia, Pa.

(Continued on page 58.)

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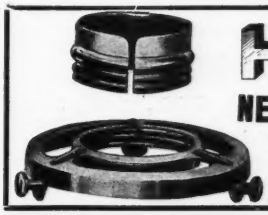

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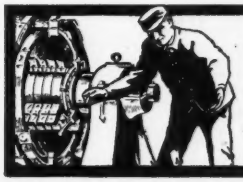

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(*Continued from page 57.*)

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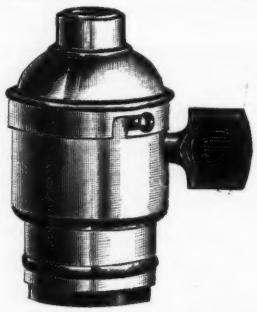
STEPHEN H. GODDARD,
Secretary.

September 14, 1904.



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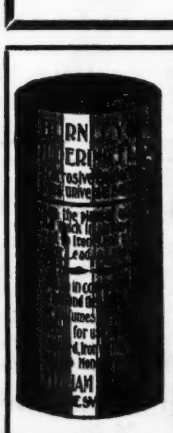

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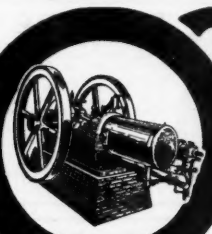

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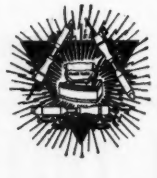

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